MOTOROLA INC.

test equipment

Trunked Radio Test Option OPERATOR'S MANUAL

R-2021D

68P80310B08-A

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Communications
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R-2021D
Trunked Radio
Test Option
OPERATOR'S MANUAL

Motorola
Test Equipment Products

1313 E. Algonquin Rd., Schaumburg, IL 60196

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Section 1
Introduction

Trunking

Trunking is the automatic sharing of a small number of communication paths (trunks) among a large number of users. Its most important asset is the ability to dramatically reduce channel waiting times, as compared to waiting times in conventional systems. Trunking can efficiently distribute the message traffic equally among the available channels because:

the percentage of times a user requires the communications link is small

the probability that many users will require a trunk at the same instant is extremely small

The same techniques used in telephone applications of trunking can be used in two-way radio systems.

A trunked radio system is similar to a cellular radio system in that the entire system, including mobile radios and fixed equipment, operates under the control of a central controller. The trunked system usually has a single centralized site, instead of multiple sites or cells. It is also more dispatch oriented—you can address groups of individuals of varying size and level. Channels are shared in a more efficient way to gain spectrum efficiency and provide better service.

The microprocessor-based central controller directs the operation of the trunked radio system and manages the flow of communications—including the selection and assignment of voice channels—among the system users. Because no two groups are assigned the same channel at the same time, interference is eliminated and privacy ensured. This results in reliable, simple, and automatic two-way radio communications.

How does trunking work? It first lets many people share a limited number of radio frequencies. When you want to contact someone or that person wants to contact you, a communications path, called a repeater, is assigned to whoever begins the transmission. You

don't have to monitor the channel and make repeated attempts to gain system access. If all channels are busy, your radio gives a busy tone. When a channel becomes available, your radio is assigned to that channel automatically and you hear a talk permit tone.

When you end the conversation, the repeater is free for assignment to other users. This sharing of frequencies is the heart of a trunked radio system, and it's accomplished automatically through the use of multiple repeaters and a central controller. Trunked systems offer other advantages including elimination of frequency selection, squelch controls, and channel monitoring.

Communication trunking has one main goal: to improve a system's efficiency by sharing its resources among many users. Although telephone companies have used trunking for years, Motorola has pioneered its use in the two-way radio industry.

The R-2021D Trunked Radio Test Option

The R-2001D is the latest model in a family of widely accepted Communications System Analyzer products that originated with the R-2001A in 1979. The Trunked Radio Test Option is an enhancement of the R-2001D Communications System Analyzer. The R-2021D has all of the measurement capabilities of the basic R-2001D, plus the capability to fully test Motorola trunked mobile and portable radios. It does this by simulating the central controller of a trunked radio system. Now you can fully simulate the calling process that the central controller performs for both inbound and outbound calls. No more guessing about whether a radio will really work on a system under all conditions.

The R-2021D is compatible with the 806 to 821 MHz and 851 to 866 MHz band plan in the Motorola Trunked Format. The radio system employs the following equipment:

central controller
base repeater stations (as required)
RF control stations (as required)
mobile radio units (as required)

Figure 1-1 illustrates a basic five-channel system configuration (up to twenty channels are available) that is centrally located in the area requiring radio coverage. For simplification, only three of the many

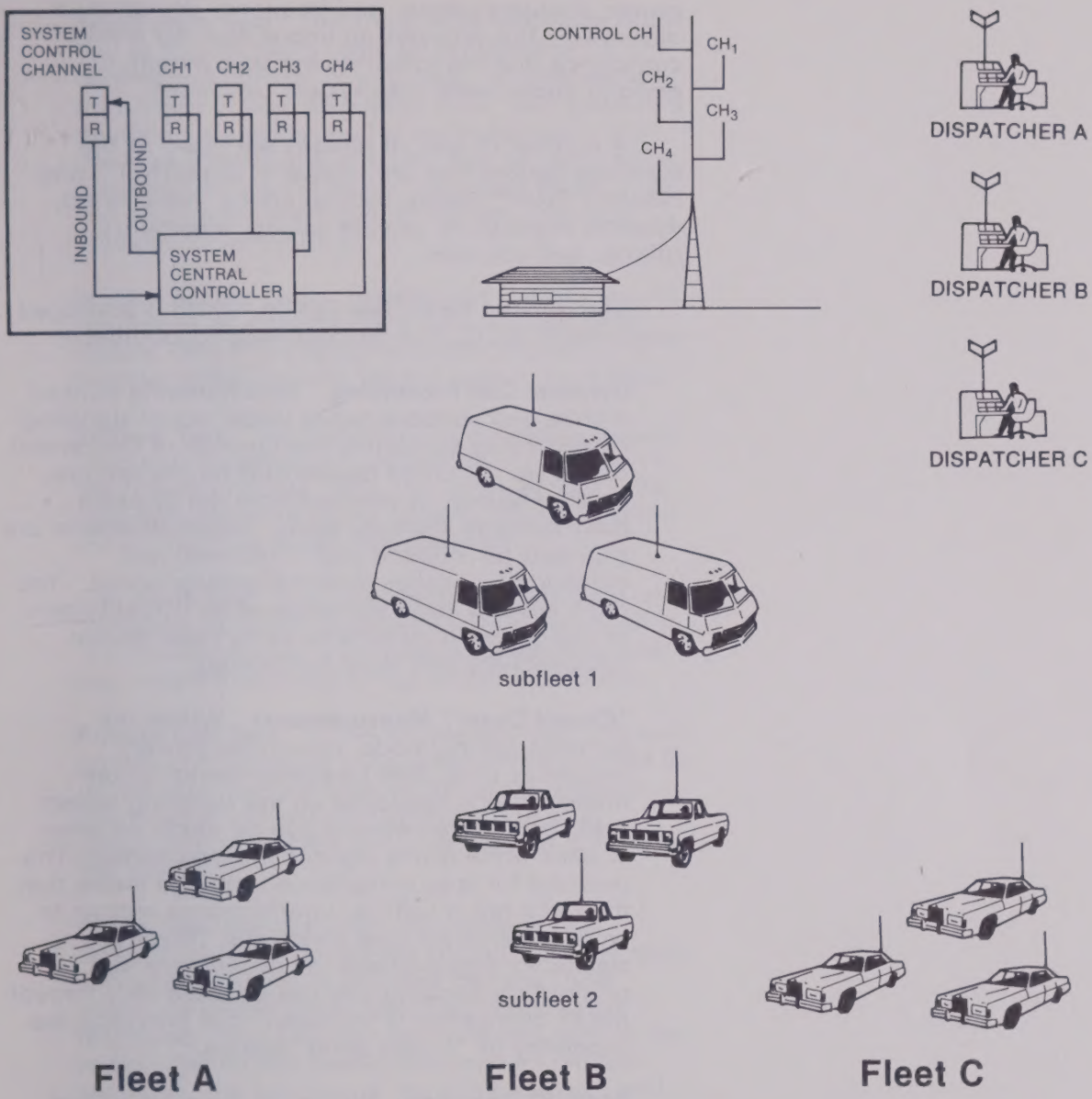


FIGURE 1-1
Five-channel system

possible user fleets are shown. Each fleet employs an RF control station (dispatcher) and one or more groups of radio-equipped vehicles.

Testing with the Trunked Radio Test Option entails call processing and direction to a pre-determined voice channel where performance of the radio is measured using the general purpose RF test capabilities of the Communications System Analyzer. You can test a radio under actual dynamic signaling conditions at any RF level. Basic inbound and outbound signaling is verified and spec compliance data of the radio (RF transmitter

power, frequency error, and frequency deviation) is displayed. This provides an unprecedented level of confidence that the radio has the spec margin to perform under worst case system conditions.

A number of special screens test many of the signaling options that are unique to SMARTNET™ and PRIVACY PLUS™ radios, such as phone interconnect, dynamic regrouping, private calling, emergency calling, and call alert.

The Trunked Radio Test Option, which is packaged within the R-2021D, has the following capabilities:

Dynamic Call Processing Tests Motorola trunked mobile and portable radios under actual signaling conditions by simulating the function of the central controller. Channel frequencies for the test are entered directly or recalled from the 32-place nonvolatile RF memory table. Separate screens are provided for inbound (radio initiated) and outbound (controller initiated) calling modes. You don't have to be in the range of an actual system or use valuable air time to verify radio system compatiblility and basic functioning.

"Closed Cover" Measurements Within the dynamic calling mode, transmitter power, frequency error, and frequency deviation are measured and displayed on the signaling screen. Additional measurements can be made on other screens while active signaling is maintained. This provides for spec compliance testing to insure that the radio has a sufficient performance margin to work under worst case conditions. There is a significant improvement in convenience and productivity because you can do these tests through the RF connection to the radio, thus providing the capability of "closed cover" testing.

Radio ID Decoding Within the dynamic calling mode, the fleet ID, subfleet ID, and unit ID portions of the radio's code plug are decoded from the transmitted Inbound Signaling Word and displayed. This helps resolve system problems due to an improperly programmed code plug, and allows you to test various front panel system and subfleet switching functions. For proper decoding, you must enter the system size codes in a special System Configuration screen, which provides nonvolatile storage of size code configurations for up to four systems.

Trunk Auto Test The Trunk Auto test mode allows you to rapidly test a radio on an operator determined number of channels. ID information, transmitter power, frequency error, and frequency deviation are displayed for each channel. This provides a rapid and efficient way to verify radio operation across the entire frequency band. You can also obtain a printout of the test data and decoded ID information.

System Access Tests Special test screens provide simulation of a busy system and verification of mobile retry. This tests the radio's capability to function under heavily loaded system conditions.

Failsoft Test The Failsoft test simulates a failsoft condition by generating appropriate signaling on the failsoft channel. You can verify proper code plug programming of the failsoft channel and the radio's function under this condition.

Call Alert Test Call Alert tests both inbound and outbound call alert with acknowledge verification. This verifies proper code plug programming and the radio's basic functioning in call alert mode.

Private Call Test In the Private Call test, inbound private call signaling is decoded and the called ID information and the type of call are displayed. The Private Call test also verifies code plug programming and the basic private call function of the radio.

Phone Interconnect Test This feature tests inbound phone interconnect calling from the radio. Off-hook signaling is decoded and the DTMF outbound dialed digits are also decoded and displayed. You can also test outgoing calls to the radio. The radio's phone interconnect request signaling, the function of the DTMF keypad, and code plug programming can be verified.

Section 2
Setup and General Information

This manual provides information and operating instructions for the R-2021D Communications System Analyzer's Trunked Radio Test Option. We assume that you are already familiar with the operation of the R-2001D and trunked radio systems. For information about a specific radio, consult the radio's service manual; for the R-2001D System Analyzer, consult the R-2001D Operator's Manual (part number 68-81069A66).

After setup instructions, the manual provides an overview of the trunking tests. Before you can use the Trunked Radio Test Option, system information must be entered in the System Configuration screen. This procedure is explained, and you can work through specific examples of entering system information in the System Configuration screen. Next, detailed instructions show you how to use the different trunking tests. In addition, an Appendix lists error and warning messages. When you are more experienced in operating the Trunked Radio Test Option, a quick reference guide provides a summary of the different test modes.

Setup

Caution: When testing a radio, the R-2021D generates a control channel type of signal. Care should be taken to prevent this from unintentionally "capturing" other radios in the area. Observe the following precautions:

Do not use an antenna on the R-2021D for over-the-air testing.

Use double-shielded cables on the R-2021D to carry signals to and from the radio.

Locate the R-2021D at least ten feet from the antenna of a unit that is working in the same system that the R-2021D is testing.

These precautions are especially important when you perform such special tests as Emergency call.

Connecting a Radio

To connect the R-2021D to a radio you need the following accessories, which are available in separate kits:

58-80345B09 RF Iso-T coupler, 40 dB at 850 MHz

01-80352A02 BNC cable

Connect the RF In/Out port to the direct port of the Iso-T coupler, and connect the radio being tested to the other end of the direct port. Then connect the DUPLEX GEN port to the coupled port. Refer to figure 2-1. The 58-80345B09 coupler has a fixed 40 dB attenuation. For the variable RF coupler (58-80313B37), adjust the coupled port until it is backed out between 1/8 to 3/8 inch from the full-in position. Coupling tighter or looser than this will cause inaccuracies.

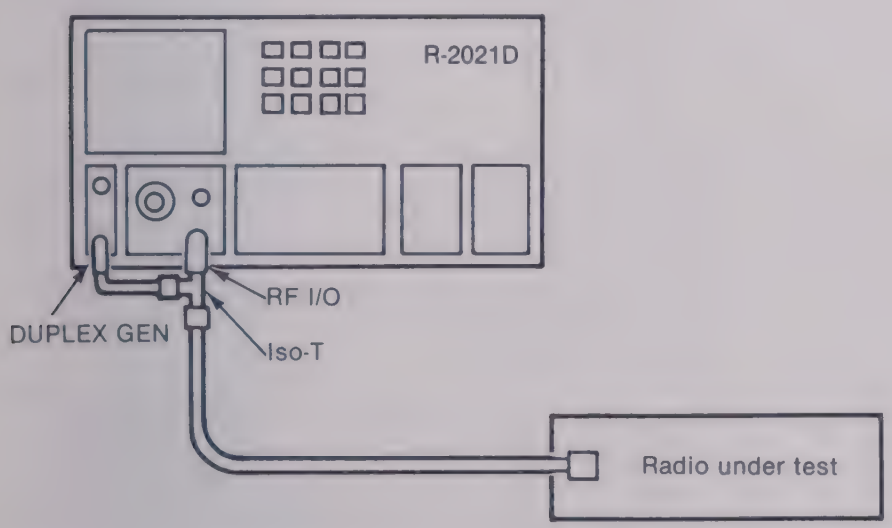


FIGURE 2-1
Connecting R-2021D to a radio

Connecting a Printer

On the side of the R-2021D is a 5-pin DIN type printer output connection. This connection can be used to generate and receive RS-232 signals similar to those in a personal computer. When the R-2021D and the printer are properly connected and configured, you can print the data displayed on the screen.

Many types of printers can be used with the R-2021D, including the following printers from Motorola:

RT-RX80/8143
RT-RX80/8143/220 (220 volt version)

The printer cable is a Motorola RTK-4081A. You can also use a serial printer cable for an Apple IIc®.

Printer Port Configuration

Using special function 75, you can set up the R-2021D for a specific RS-232 configuration. When you select this special function, the Printer Init screen is displayed, as in figure 2-2. This screen shows the default values in the R-2021D that occur when doing a special function 79 (default reset). To change any of these values, move the cursor to the line you want to change and enter the number. The options for each of the selections are as follows:

```
PRINTER INIT (SPFC 75)     SEL)
 1) EXIT

BAUD RATE SEL  5) 1200 BAUD

STOP BITS SEL  1) 1 STOP BIT

PARITY SEL     1) NO PARITY

AUTO LINE FEED 1) YES

TRANSMIT BITS/CHAR  2) 8 BITS
```

FIGURE 2-2
Printer Init screen

Baud Rate:
1 75 baud
2 150 baud
3 300 baud
4 600 baud
5 1200 baud (default value)
6 2400 baud
7 4800 baud
8 9600 baud

Stop Bits
1 1 stop bit/character (default value)
2 1.5 stop bits/character
3 2 stop bits/character

Parity
1 no parity (default value)
2 even parity
3 odd parity

Auto Line Feed
1 on (default value)
2 off

Transmit Bits
1 7 bits/character
2 8 bits/character (default state)

If you change any of these values, the changes are retained in nonvolatile memory until a special function 79 is used.

Apple IIc is a registered trademark of Apple Computer Corp.

Printing the Screen

To print a screen, simultaneously press the 0 key and the left cursor key. Any characters displayed on the screen are printed directly. If a bar graph is displayed, the # character is printed to show the length of the bar. Waveforms cannot be printed. While printing, the system is "locked"—no further operations are allowed until printing is finished.

If you try to print the screen when the printer is off-line, a "PRINTER BUSY" message is displayed for 3 seconds (unless a waveform screen is displayed). If the R-2021D's character buffer is full, a "WAIT" message will appear for about 3 seconds. When the printer accepts the output, you'll hear a beep from the R-2021D's speaker.

Trunking Tests: General Information

The R-2021D Trunking Option consists of three general tests: the Radio Init test, the Trunk Auto test, and the Controller Init test. Another test option, Special Tests, accesses a menu that contains additional trunking tests. You can end any trunking test at any time by pressing 1.

Pretest Adjustments

Before using the Radio Init test, Trunk Auto test, and Controller Init test, you must make adjustments and selections to the switches on the front panel of the R-2021D. If any of the front panel switches are not in the correct position when you begin the test, the names of those switches are displayed and you are prompted to correct them.

Thermometer Graphic

Some test screens (for example, the Radio Init, Trunk Auto, and Controller Init tests) have a thermometer style graphic. This thermometer indicates the major signaling events within the calling process. Before a test begins, you can display help messages that correspond to the signaling events by moving the cursor across the numbers in the thermometer. (The help messages appear to the right of the thermometer.) Move the cursor right by pressing any number key and move it left by pressing the left cursor key. As the test progresses, each number in the thermometer lights up

and its identifying help message is displayed. If the radio fails at any point, the test and the thermometer display stop at the last *completed* step. This helps in troubleshooting when the calling sequence is not completed.

Entering Information

You need to enter information before a test can begin. For example, you might have to enter the system ID, control channel frequency, and voice channel frequency. The system ID and frequencies of the most recently entered data or received data are sometimes transferred to the test screen. If you previously ran a test, the system ID and channels of that test may be displayed in the test screen.

The system ID must be entered as a four-digit hexadecimal number. Use the display keys on the front panel to enter digits A through F. Refer to figure 2-3. If a system ID is already displayed on the screen and you want to change it, just enter the new system ID over the old.

The control and voice channel frequencies can be entered manually or by recalling a two-digit preset number from the RF memory table. To enter a frequency manually, enter the new frequency over the old frequency. To recall a frequency, position the cursor at the two dashes after CC (control channel) or VC (voice channel) and enter the frequency's preset

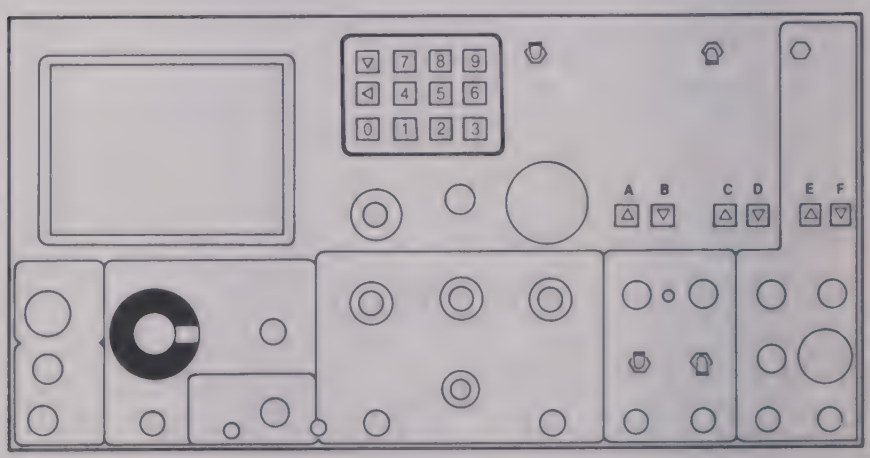


FIGURE 2-3
Display keys on the R-2021D

number from the RF memory table. (You can change the preset frequencies in the RF memory table to correspond to the frequencies you're using in the trunked tests by going to the RF Memory display screen.) All frequency entries must be the radio's receive frequencies (851.0000 MHz to 865.9875 MHz); if they aren't, the R-2021D will indicate an ERROR 03 after the test starts.

Temporary Exit

Some tests have a temporary exit option. This option is displayed at the top of the screen after the test begins. When you choose a temporary exit, the call is held active while you use the up or down display keys to select other displays for further testing. (But you can't go to any other signaling sequence screen.) *There is a short delay before you can key the transmitter when going from one display to another.*

Note: You must have the radio keyed before you go to the Spectrum Analyzer screen. If the radio is keyed before you go to the Spectrum Analyzer screen and continues to be keyed while in this screen, you can see the radio's transmission. *The radio cannot be dekeyed and rekeyed in the Spectrum Analyzer screen.*

To return to a test after a temporary exit, choose the Signaling Sequence display. The test will be in the same state as before the temporary exit.

Reset

Some tests must be reset before they can be run again. When this is the case, a reset option is displayed at the top of the screen when the test ends. If you want to enter new data on the test screen, you must choose the reset option. When you select this option, the screen is reset to its pre-test state (but the system ID, control channel frequency, and voice channel frequency are retained). The test can then be repeated on different voice channels or with different systems, fleets, or subfleets.

DTMF

For full testing of the Phone Interconnect special test, Dual Tone Multiple Frequency (DTMF) is included in

the R-2021D. You can select this function within the Phone Interconnect special test, as discussed in the section on the Phone Interconnect test. DTMF can also be used from other modes in the R-2021D. The following section describes the general use of the DTMF capability.

The following special functions are used to control both DTMF encode and decode.

Special Function 15 Special function 15 accesses the DTMF screen. The front panel's up/down selection keys function as A, B, C, D, *, and # tone keys. While in special function 15, switches and buttons that are not used for DTMF do not function.

Special Function 16 In special function 16, the front panel's number keys and up/down selection keys switch to DTMF function but the DTMF screen is not displayed. Some uses of special function 16 include setting deviation or observing a waveform on the screen while manually generating DTMF tones by pressing the front panel keys.

Special Function 17 Special function 17 cancels special function 16 and returns the front panel controls to normal operation.

To activate a special function, press both cursor keys simultaneously and enter the special function number when the selection screen appears.

DTMF Screen

To display the DTMF screen, enter special function 15. The DTMF screen, shown in figure 2-4, is used for both encode and decode mode. The DTMF decoder receives its signal from the CRT signals. To decode reliably, the signal amplitude must be adjusted for a peak-to-peak level of 25% to 100% of the total screen height when displayed on the oscilloscope. Use the Vert sensitivity controls to adjust the amplitude. The default condition is to decode the signal from the receiver (off the air). To decode from the front panel's Vert input, you need to access special function 11. You can cancel special function 11 by a special function 10.

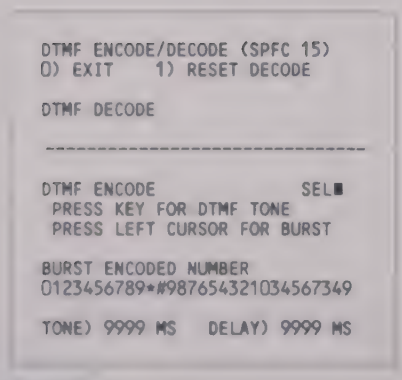


FIGURE 2-4
DTMF screen

Note: In all cases, you must select the Vert sensitivity position and Display screen before entering the DTMF screen. These controls have no effect while in the DTMF screen.

When you have selected the DTMF screen, DTMF decode is automatic. The decoded DTMF digits are displayed sequentially under DTMF DECODE. Up to 30 digits can be displayed. To decode correctly, the length of the tones must be at least 40 milliseconds and there must be at least a 40 millisecond delay between tones. To clear the DTMF decode line, enter 1 at the top of the screen, by RESET DECODE.

The lower half of the screen is for DTMF encode. When you move the cursor to the SEL area (opposite DTMF ENCODE), a help message automatically appears. If you press and hold a DTMF key at this time, the tone is generated and remains on until you release the key.

DTMF tone sequences are entered and generated by moving the cursor to the area under BURST ENCODED NUMBER. If a number is already displayed, it will be erased when you enter the first digit of the new tone. If you want to alter (rather than erase) the displayed number, use the left cursor key to position the cursor over the digit you want to change.

You can enter the length of the automatic tones at the bottom of the screen, by TONE. The delay between tones can also be set on this line, to the right of DELAY. The length and delay are set independently, from 1 millisecond to 9.999 seconds in 1 millisecond steps. To function properly, most systems require at least a 40 millisecond tone and delay. To start the DTMF tone sequence, move the cursor to the mid-screen position, by DTMF ENCODE, and press the left cursor key. This starts the burst.

Mulitple modulations are possible with DTMF. Any PL, DPL, Tone A, Tone B, or tone sequence can be activated before entering the DTMF screen and will continue during DTMF generation. The level for DTMF is controlled by the Ext Level knob on the front panel. The level of the other tones can be set separately by the Code Synth Lvl knob. For example, you can set the PL tone to its standard low deviation to access a phone interconnect system, and set the voice and DTMF to a higher level to actually use the system.

Normal speech in the microphone supplied with the R-2021D will result in a modulation level close to that of the DTMF signal. To disconnect DTMF, connect a low impedance signal generator to the BNC Ext Mod In port.

To exit the DTMF screen, move the cursor to the top of the screen and press 0. If a DTMF sequence is in progress when you exit the DTMF screen, the sequence will be completed.

```
SIGNALING SEQUENCE MODE SEL) 8

1) A/B ENCODE
2) 5/6 TN ENCODE/DECODE
3) SELECT V ENCODE/DECODE
4) PL DECODE
5) DPL DECODE
6) GENERAL-SEQ ENCODE/DECODE
7) MOBILE TELEPHONE
8) TRUNKING

MON/GEN SW FOR DECODE/ENCODE
```

FIGURE 2-5
Signaling Sequence Menu

```
SIGNALING SEQUENCE MODE SEL) 8
       ENTER 0 FOR MENU

TRUNKING                    SEL)

1) RADIO INIT TEST
2) CONTROLLER INIT TEST
3) TRUNK AUTO TEST
4) SPECIAL TEST MODE
5) SYSTEM CONFIGURATION
```

FIGURE 2-6
Trunking Menu

```
TRUNK SYSTEM CONFIG          SEL)
 1) EXIT

 SYS NO.  0509 0002 0003 0004

 FLEET    SIZE SIZE SIZE SIZE
 PREFIX   CODE CODE CODE CODE
   0        00   00   00   00
   1        00   00   00   00
   2        01   01   01   01
   3        01   01   01   01
   4        02   02   02   02
   5        02   02   02   02
   6        03   03   03   03
   7        03   03   03   03
```

FIGURE 2-7
System Configuration screen

Trunking Menu

You enter the Trunked Radio Test Option from the Signaling Sequence screen. In the Signaling Sequence screen, a menu is displayed as in figure 2-5. Select the number that corresponds to the Trunking option. The Trunking Menu, shown in figure 2-6, is displayed.

From the Trunking Menu, you can enter any of the trunking tests. Option 4, Special Test Mode, accesses an additional menu that contains special trunking tests. Data entered in any trunking screen is stored in nonvolatile memory—this data is saved even when the R-2021D is turned off.

System Configuration Option

To decode fleet, subfleet, and unit ID information, you have to enter system configuration information before beginning a test. System configurations for up to four systems can be stored in nonvolatile memory; thus, you only have to enter this system configuration information once (unless you will be testing more than four different systems).

In the Trunking Menu, position the cursor to the right of TRUNKING SEL. Press 5 to select the System Configuration option. The System Configuration screen is displayed as in figure 2-7.

System Configuration Screen

The system ID and size codes of the radio being tested constitute a fleet map. The fleet map must be entered in the System Configuration screen for the R-2021D to correctly decode the ID information transmitted by the radio in its Inbound Signaling Word (ISW).

The first item to enter in the System Configuration screen is the system ID. The radio you're testing should have a user label that contains a 10-digit hexadecimal number. In a hexadecimal system, numbers 10 through 15 (decimal) are represented by the letters A through F. For example, suppose the user label has the following hexadecimal number:

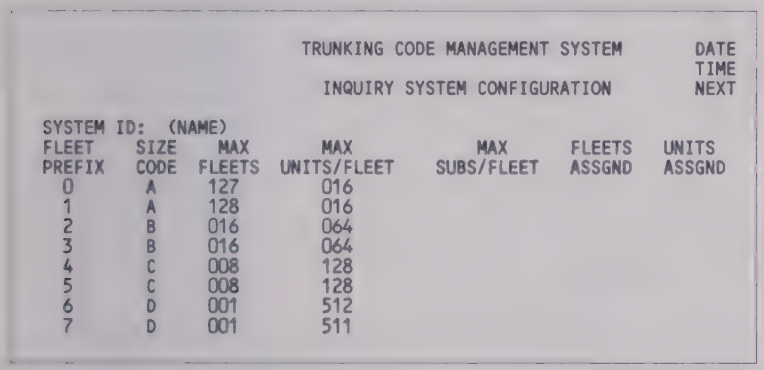
0A09400001

This represents:

System ID	Fleet ID	Individual ID
0A09	400	001
	↑	
	Fleet prefix	

The first four numbers are the system ID. The next three numbers are the fleet ID, and the last three are the individual radio's ID. Note that the fleet prefix is the first number of the three-digit fleet ID. Numbers are entered using the keypad. You can enter letters with the display keys on the front panel. Refer back to figure 2-3.

Each trunking system configuration contains a set of eight size codes. Each size code is designated by a single letter. The system configuration information can best be determined from the system manager for each system. This information is usually not listed on any of the labels on the radio. System configuration information is also in the Motorola Trunking Code Management System, in the second column of data within the Inquiry System Configuration, as shown in figure 2-8.



TRUNKING CODE MANAGEMENT SYSTEM DATE TIME

INQUIRY SYSTEM CONFIGURATION NEXT

SYSTEM ID: (NAME)

FLEET PREFIX	SIZE CODE	MAX FLEETS	MAX UNITS/FLEET	MAX SUBS/FLEET	FLEETS ASSGND	UNITS ASSGND
0	A	127	016			
1	A	128	016			
2	B	016	064			
3	B	016	064			
4	C	008	128			
5	C	008	128			
6	D	001	512			
7	D	001	511			

FIGURE 2-8
Inquiry System Configuration

Because there aren't enough keys on the R-2021D to enter all of the letters in the alphabet, a number is used to represent each size code letter. Table 1 lists each size code letter and its corresponding number.

Size Code Letter	Size Code Number	Size Code Letter	Size Code Number
A	00	J	09
B	01	K	10
C	02	L	11
D	03	M	12
E	04	N	13
F	05	O	14
G	06	P	15
H	07	Q	16
I	08	Z	99

TABLE 1
Size code letters and numbers

In the System Configuration screen, the size codes are entered below their system ID (SYS NO). There is space to enter four systems, so you can test radios on different systems without going to the System Configuration screen for each.

Warning: If the size codes are entered incorrectly, some tests will still run but the tests results will be incorrect. You won't know that the size codes are incorrect unless you check the information displayed in the Radio Init screen. The 10-digit hexadecimal number from the user label should match the information in the Radio Init screen. *YOU MUST BE CAREFUL AND ENTER THIS INFORMATION CORRECTLY.*

We'll work through a few examples of how to enter system IDs and size codes in the System Configuration screen. There are two things you need to enter information in this screen: the 10-digit hexadecimal number from the user label (for the system ID) and the size codes for the system.

Let's suppose the user label's 10-digit hexadecimal number is:

0C08300001

With this number, we can determine the system ID, fleet ID, fleet prefix, and individual ID.

System ID:	0C08
Fleet ID:	300
Fleet prefix:	3
Individual ID:	001

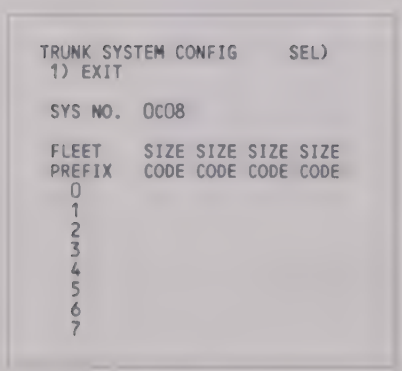


FIGURE 2-9
System Configuration screen (system ID entered)

First, we enter the system ID number to the right of SYS NO. See figure 2-9. Then, we determine that we have the following size codes:

AABBCCDD

Using Table 1, we convert these size codes to:

A	00
A	00
B	01
B	01
C	02
C	02
D	03
D	03

Then we enter these numbers below their system ID. See figure 2-10.

Now we'll enter a fleet map (system ID and size codes) for a second system. Suppose the user label is:

01A54001A9

Therefore, the system ID is 01A5. The size codes are:

N
Z
Z
Z
L
Z
J
K

Again, using Table 1, we convert the size codes as follows:

N	13
Z	99
Z	99
Z	99
L	11
Z	99
J	09
K	10

We enter this information in the System Configuration screen, as in figure 2-11.

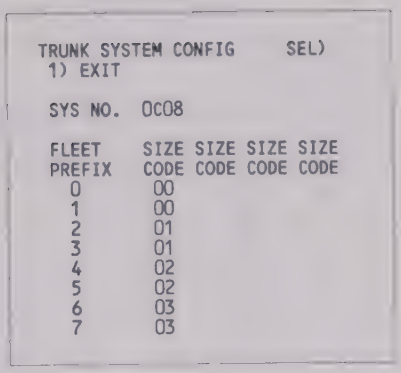
Finally, we'll enter two more systems (for a total of four systems). Suppose the 10-digit hexadecimal number from the user label is:

0123000706

and the size codes are:

P
Z
Z
Z
Z
Z
Z
Z

We convert the size codes, and enter the system ID and size codes in the System Configuration screen. The screen would now look like figure 2-12.

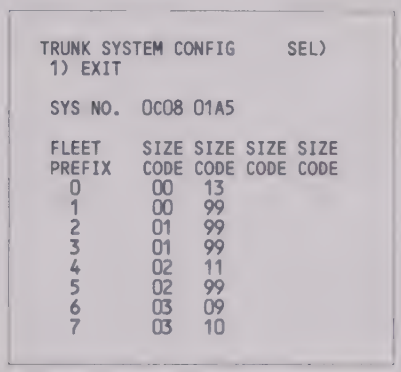


```
TRUNK SYSTEM CONFIG      SEL)
 1) EXIT

 SYS NO.  0C08

 FLEET    SIZE SIZE SIZE SIZE
 PREFIX   CODE CODE CODE CODE
   0       00
   1       00
   2       01
   3       01
   4       02
   5       02
   6       03
   7       03
```

FIGURE 2-10
System Configuration screen (size codes entered)

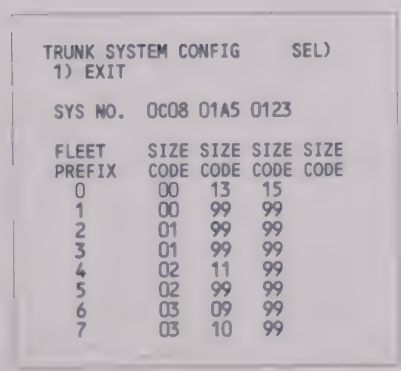


```
TRUNK SYSTEM CONFIG      SEL)
 1) EXIT

 SYS NO.  0C08 01A5

 FLEET    SIZE SIZE SIZE SIZE
 PREFIX   CODE CODE CODE CODE
   0       00   13
   1       00   99
   2       01   99
   3       01   99
   4       02   11
   5       02   99
   6       03   09
   7       03   10
```

FIGURE 2-11
System Configuration screen (second system ID and size codes entered)



```
TRUNK SYSTEM CONFIG      SEL)
 1) EXIT

 SYS NO.  0C08 01A5 0123

 FLEET    SIZE SIZE SIZE SIZE
 PREFIX   CODE CODE CODE CODE
   0       00   13   15
   1       00   99   99
   2       01   99   99
   3       01   99   99
   4       02   11   99
   5       02   99   99
   6       03   09   99
   7       03   10   99
```

FIGURE 2-12
System Configuration screen (third system ID and size codes entered)

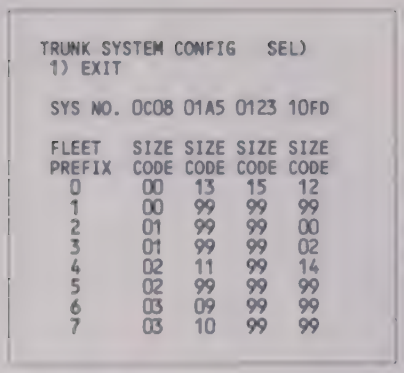


FIGURE 2-13
System Configuration screen (fourth system ID and size codes entered)

The last system's 10-digit hexadecimal number is:

10FD23100C

The size codes are:

M
Z
A
C
O
Z
Z
Z

Again, we convert the size codes, and enter the system ID and converted size codes in the System Configuration screen. Figure 2-13 shows the System Configuration screen with all four systems entered.

In summary, to enter information in the System Configuration screen you first obtain the system ID from the 10-digit hexadecimal number on the user label. Then, determine the size code configuration of your system from the system manager. Convert the size codes using Table 1. In the System Configuration screen, enter the system ID; then enter the size code numbers below the system ID and opposite the appropriate fleet prefix digits.

When you have finished entering the system ID and size code numbers, position the cursor at SEL in the System Configuration screen and press 1 to exit to the Trunking Menu. In the next sections, we'll describe the different trunking tests.

Problems

- Error 04 is displayed
  System ID and/or size codes in the System Configuration screen are incorrect for this system.

- Error 05 is displayed
  One of the numbers in the System Configuration screen is invalid. Valid entries are 00 through 16 and 99.

Section 3
Radio Init, Trunk Auto, and Controller Init Tests

Radio Init Test Option

You use the Radio Init option to test the radio's ability to access the system and to call another radio. The Radio Init option first tests the radio's signaling functions. It then displays RF transmitter power, frequency error, and frequency deviation information so you can check the radio's RF functions. The radio's code plug information—fleet ID and unit ID—is shown to verify correct code plug programming.

Pretest Adjustments

Before you begin the test, make the following adjustments and selections to the switches on the front panel of the R-2021D:

DUPLEX GEN	On
RF Port Sel	RF In/Out
RF Step Attenuator	-50 dB Min*
Image/Dplx	High
BW	Narrow
Squelch	Off
DISPLAY	Signaling Seq
FUNCTION	Monitor-FM

*If the radio is connected to the R-2021D by a cable (refer back to figure 2-1) and the R-2021D's attenuation is set to 0, the radio's synthesizer feedthrough will be received before the radio's transmitter is turned on. This might cause an error. If you are performing an "over the air" test or testing a radio that is transmitting very low power, the attenuation will need to be decreased from −50 dB.

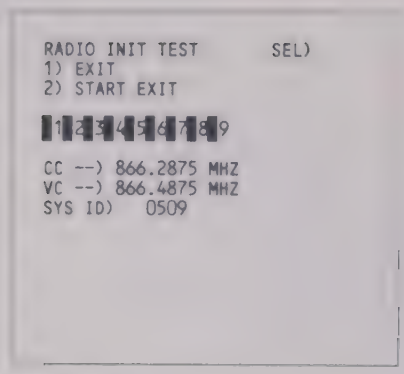


FIGURE 3-1
Radio Init (pretest)

The Test Screen

From the Trunking Menu, press 1 to enter the Radio Init test screen. See figure 3-1. In the center of the screen, a thermometer style graphic indicates the major signaling events within the calling process. Steps 1 through 8 test signaling ability and handshaking, step 9 checks the frequency, RF, and modulation. These events are:

#	Help Message	Explanation
1	CC IDLE	The R-2021D is outputting a background pattern on the control channel frequency for the radio to lock onto.
2	ISW RCVD	The radio has sent an Inbound Signaling Word (ISW) on the control channel frequency to indicate that it has called. (This occurs when the radio is keyed.)
3	CHAN GRANT	The R-2021D is sending channel grant signaling words on the control channel frequency to indicate which voice channel the radio should go to.
4	OBD HS ACK	At the same time as the CHAN GRANT, the R-2021D is sending high speed acknowledge words on the voice channel frequency.
5	IBD HS ACK	The radio is sending a high speed acknowledge tone on the voice channel frequency to indicate that it has received the OBD HS ACK on the voice channel.
6	OBD CONN	The R-2021D is sending an outbound connect word on the voice channel frequency to indicate that it has received the IBD HS ACK on the voice channel.
7	CONN ON VC	The radio is sending a connect tone on the voice channel frequency to indicate that it is on the voice channel. (The connect tone stays on the voice channel frequency as long as the radio is keyed.)

8 DISC RCVD The radio has sent a disconnect tone to the R-2021D (the base) on the voice channel to indicate that it has dekeyed and is releasing the voice channel to another radio or the base. DISC RCVD verifies the receipt of proper disconnect signaling.

9 DISC SENT The R-2021D sends a disconnect word on the voice channel frequency to end the call on that voice channel. The radio will return to the control channel. (Only sent when you press 1.)

In the lower portion of the screen, enter:

control channel frequency
voice channel frequency
system ID

To decode the radio's ID information, the system ID must match one of the system IDs in the System Configuration screen.

The Test

Initiate the test by moving the cursor to the right of SEL and pressing 2. The R-2021D checks all data entered on the screen and, if everything is correct, the test starts. If there is a problem with the entered data, an error message appears. For a list of error and warning messages, refer to the Appendix.

Note: If you enter a system ID that is not in the System Configuration screen, the test will run but the ID information cannot be decoded and displayed. (However, the power, frequency error, frequency deviation, and connect tone are displayed.) A WARNING 01 also occurs.

The R-2021D automatically enables the 20 KHz lowpass and 5 Hz highpass receive filters by selecting filter special functions 23 and 24. At the end of the test, the receive filters are returned to their pre-test states (even if you enter filter special functions 20 through 26 during a temporary exit).

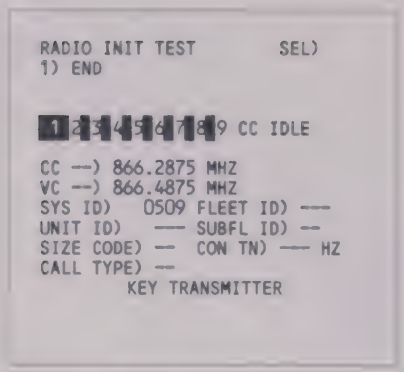

RADIO INIT TEST SEL)
1) END
CC IDLE
CC --) 866.2875 MHZ
VC --) 866.4875 MHZ
SYS ID) 0509 FLEET ID) ---
UNIT ID) --- SUBFL ID) --
SIZE CODE) -- CON TN) --- HZ
CALL TYPE) --
KEY TRANSMITTER

FIGURE 3-2
Radio Init (during test)

After the test starts, the synthesizer on the R-2021D's trunking option board generates outbound idle patterns and system ID OSWs on the designated control channel through the DUPLEX GEN output. At this time, "CC IDLE" is displayed. The R-2021D's MONITOR receiver is on the inbound control channel waiting for an ISW from the radio.

A beep-beep alarm sounds and a flashing message appears on the screen prompting you to key the radio, as shown in figure 3-2. The "KEY TRANSMITTER" prompt indicates that you can key the radio to complete a call.

Press the PTT switch to initiate the call. When you key up, the radio sends an ISW on the control channel frequency to indicate that it is calling. The R-2021D decodes the received ISW and displays the radio's fleet ID, subfleet ID, unit ID, and size code. The type of call that was made is also displayed as alphanumeric characters. Refer to appendix for description of call types.

The R-2021D switches its receiver to the designated voice channel while the control channel synthesizer continues with outbound signaling. The R-2021D sends a channel grant signaling word on the control channel frequency to tell the radio which voice channel to use. At the same time, it sends a high speed acknowledge on the voice channel frequency.

Then the radio sends a high speed acknowledge tone on the voice channel frequency to indicate that it has received the high speed acknowledge. The R-2021D responds by sending an outbound connect word on the voice channel frequency to indicate that it has received the radio's acknowledge.

The thermometer display progresses rapidly through this acknowledge and connect signaling and stops *after* step 7, CONN ON VC. The radio has sent a connect tone on the voice channel frequency to indicate that it is on the voice channel. The connect tone stays on the voice channel as long as the radio is keyed. In addition to the information already on the screen, the connect tone frequency is calculated and displayed.

Note: After the connect tone frequency is displayed, it is not updated for the remainder of the test.

To complete step 8, you must dekey the radio to initiate transmission of the disconnect signaling. When 8 is completed, the R-2021D has confirmed receipt of proper disconnect signaling from the radio. You can then re-key the radio to measure frequency error (ERR KHZ), RF transmitter power (PWR W), and frequency deviation (DEV KHZ), as in figure 3-3. This data can only be displayed after the initial transmission test has progressed through step 8, DISC RCVD.

Connect signaling continues on the voice channel to hold the radio on the voice channel. This allows for a callback test. At this point, you can apply audio modulation in one of three ways:

turn on the 1 KHz tone
connect a tone to the External Mod In jack
talk through the microphone

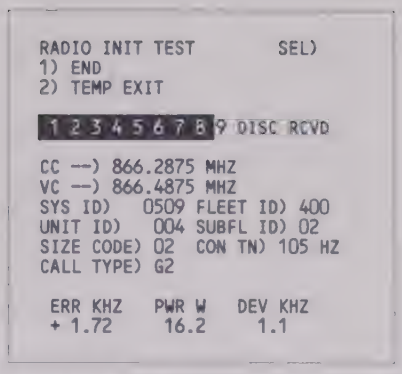

RADIO INIT TEST SEL)
1) END
2) TEMP EXIT
1 2 3 4 5 6 7 8 9 DISC RCVD
CC —) 866.2875 MHZ
VC —) 866.4875 MHZ
SYS ID) 0509 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 02
SIZE CODE) 02 CON TN) 105 HZ
CALL TYPE) G2
ERR KHZ PWR W DEV KHZ
+ 1.72 16.2 1.1

FIGURE 3-3
Radio Init (during test)

Note: When in a temporary exit, you can transmit voice from the R-2021D only in the Duplex Gen display screen. If the radio drops off of the voice channel for any reason during the test, it will be directed back to the voice channel when it returns to the control channel because the R-2021D maintains active control channel signaling during voice channel operation (like the actual system).

To complete step 9 and end the test, press 1. (Before ending the test, you can go to other display screens in the R-2021D, but you must be in Signaling Sequence to end the test.) The R-2021D sends a disconnect pattern on the voice channel frequency to return the radio to the control channel. "DISC SENT" is displayed to the right of the thermometer. A "TEST COMPLETED" message is also displayed at the bottom of the screen. See figure 3-4. At this point you have two choices: you can enter 1 to exit to the Trunking Menu screen or enter 2 to reset the test.

Temporary Exit

After step 7 is completed, you can do a temporary exit by entering 2. To return to the Radio Init test after a temporary exit, choose the Signaling Sequence display.

Problems

Following are some typical problems that might occur. Possible reasons for these problems (in addition to a radio malfunction) are listed.

RADIO INIT TEST SEL)
1) EXIT
2) RESET
1 2 3 4 5 6 7 8 9 DISC SENT
CC —) 866.2875 MHZ
VC —) 866.4875 MHZ
SYS ID) 0509 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 02
SIZE CODE) 02 CON TN) 105 HZ
CALL TYPE) G2
TEST COMPLETED

FIGURE 3-4
Radio Init (after test)

- The R-2021D will not receive the ISW (step 2 on the thermometer won't light).

  The control channel entered is not a valid control channel for the radio.

  The system ID entered is not a valid system ID for the radio.

  Connections from the R-2021D to the radio are incorrect.

- Step 8 will not light.

  The disconnect tone is not being sent and there is a problem with the radio. You can still measure RF transmitter power, frequency error, and frequency deviation by doing a temporary exit and choosing the Gen/Mon display screen.

- ERROR 10 displayed continuously.

  If the radio and the R-2021D are connected by a cable, check to see if RF attenuation is set to less than −50 dB. Try increasing the RF attenuation.

- ERROR 11 is displayed continuously.

  The voice channel frequency is not a valid voice channel frequency for the radio. Verify that the radio is set to make a subfleet call. The call type displayed on the test screen should be a 5-channel subfleet call, a 20-channel subfleet call, or a fleet call. The screen will indicate the call type requested.

- Incorrect information displayed.

  An incorrect size code is entered in the System Configuration screen.

Advanced User's Notes

After step 7 is completed, you can:

Do a temporary exit

Hear modulation (voice or transmission) from the radio on the R-2021D's speaker

Send modulation to the radio by turning on the 1 KHz tone, connecting a tone to the External Mod In jack, or talking through the microphone

Measure power, frequency error, and frequency deviation

As an aid in troubleshooting system problems, you can enter FFFF for the system ID. This inhibits sending the system ID OSW (Outbound Signaling Word) on the control channel. In most radios, if a system ID OSW is not received within a certain amount of time, the radio will not transmit an ISW.

To do the Radio Init test with a system ID of FFFF, you must first turn off the radio. Then start the Radio Init test. The R-2021D outputs background OSWs on the control channel. Turn the radio on, wait at least 2 seconds (but not more than 8 seconds), and key the transmitter. Then proceed as in the Radio Init test. A WARNING 01 is displayed, and no system ID information can be decoded and displayed.

Trunk Auto Test Option

In the Trunk Auto test option, you can test the radio's ability to call another radio over several voice channels. The Trunk Auto test is very similar to the Radio Init test in that it checks the same radio functions. But the Trunk Auto test lets you check the radio over several voice channels without reentering the new voice channel every time. You can also receive a printout of the test results for each voice channel. This automated mode of testing provides a way to test a radio on a pre-determined set of channels. One use of the Trunk Auto option is testing a radio that has a reliability problem.

Pretest Adjustments

Before you begin the test, make the following adjustments and selections to the switches on the front panel of the R-2021D. These are the same selections you make in the Radio Init test.

DUPLEX GEN	On
RF Port Sel	RF In/Out
RF Step Attenuator	-50 dB Min*
Image/Dplx	High
BW	Narrow
Squelch	Off
DISPLAY	Signaling Seq
FUNCTION	Monitor-FM

*If the radio is connected to the R-2021D by a cable (refer back to figure 2-1) and the R-2021D's attenuation is set to 0, the radio's synthesizer feedthrough is received before the radio's transmitter is turned on.

This might cause an error. If you are performing an "over the air" test or testing a radio that is transmitting very low power, then the attenuation will need to be decreased from −50 dB.

The Test Screen

In the Trunk Auto test option, test frequencies can be chosen in two ways. You can use a Frequency Table mode or a Variable Step mode. From the Trunking Menu, press 3 to enter the Trunk Auto test screen. Depending on which Trunk Auto test option was last used, the screen will display either figure 3-5 (Frequency Table mode) or figure 3-6 (Variable Step mode).

Frequency Table Mode

To choose the Frequency Table mode, position the cursor in the middle of the Trunk Auto test screen, by CHANNEL SELECTION SEL, and press 1. The frequency table consists of one control channel and four voice channels, as shown in figure 3-5. You can test all channels in a five-channel system, or test the radio at specific frequencies across the band.

```
TRUNK AUTO TEST              SEL)
 1) EXIT
 2) START TEST
CHANNEL SELECTION            SEL) 1
 1) FREQUENCY TABLE
 2) VARIABLE STEP
 CC --) 866.2875 MHZ
 VC 01) 856.4875 MHZ
 VC --) 860.4875 MHZ
 VC --) 867.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
 AUTO KEY(YES=1,NO=0) 0
 PRINTER (YES=1,NO=0) 0
```

FIGURE 3-5
Trunk Auto: Frequency Table mode (pretest)

Note: Radios that are not synthesized can only be tested at specific voice channel frequencies. These frequencies should be listed on the radio.

In the Frequency Table mode of the Trunk Auto test, you need to enter:

control channel frequency
four voice channel frequencies
system ID
printer option

For the printer option, choose 1 if you want a printout of the results, choose 0 if you don't.

```
TRUNK AUTO TEST          SEL)
 1) EXIT
 2) START TEST

CHANNEL SELECTION        SEL) 2
 1) FREQUENCY TABLE
 2) VARIABLE STEP

 CC --) 866.2875 MHZ
 START VC 01) 856.4875 MHZ
 SKIP FACTOR) 050
 SYS ID) 0509


 AUTO KEY(YES=1,NO=0) 0
 PRINTER (YES=1,NO=0) 0
```

FIGURE 3-6
Trunk Auto: Variable Step mode (pretest)

Variable Step Mode

The second way to select test frequencies is using a variable step mode. To choose this mode, position the cursor in the middle of the Trunk Auto test screen, by CHANNEL SELECTION SEL, and press 2. See figure 3-6. In the Variable Step mode you can check more than five frequencies or a random sample of frequencies.

In the Variable Step mode, you have to enter:

control channel frequency
starting voice channel frequency
skip factor
system ID
printer option

A skip (or step) factor is entered (for subsequent voice channels) to indicate the number of channels the Trunk Auto test should skip to get to the next voice channel test frequency. For example, if you choose a skip factor of 100, the test will start at the voice channel you entered and progress through the band in uniform steps of 100 channels (2.5 MHz) each. This simplifies entry when specific voice channel frequencies are not critical or when a larger number of voice channel tests is required. Also enter the printer option—select 1 if you want a printout of the results, 0 if you don't.

The Test

After selecting the Frequency Table mode or the Variable Step mode, enter 2 at the top of the Trunk Auto test screen to start the test. See figure 3-7. For both modes, the screen is like the Radio Init test screen, except there is no temporary exit option.

In the center of the screen, the thermometer graphic indicates the signaling sequence for each channel. These signaling events are the same as those in the Radio Init test (refer to page 20).

The test proceeds as in a Radio Init test. You will be prompted when to key and unkey the radio. If you unkey the radio before being prompted, measurements will not be accurate. The R-2021D can automatically key the radio if a suitable customer supplied cable (using mating connector RPX-4635A) is connected between the radio and the R-2021D. Connect the cable to the Trunking I/O connector located on the side of the R-2021D. The relay closure between pins 1 and 2 should be connected across the radio key-line. (Note: These contacts allow you to use your own cable. Motorola does not supply these cables. Compatibility between the contact closure and the requirements of any radio model is not assumed.)

The received data—fleet ID, subfleet ID, unit ID, call type, and connect tone—is decoded and displayed for each channel. RF transmitter power, frequency error, and frequency deviation is also displayed. See figure 3-8. (After the results for one voice channel are displayed, keep the radio keyed if you want to review

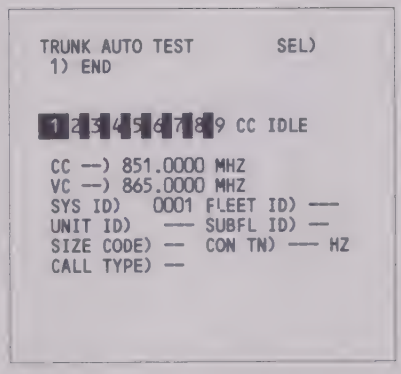

TRUNK AUTO TEST SEL)
1) END
1 2 3 4 5 6 7 8 9 CC IDLE
CC —) 851.0000 MHZ
VC —) 865.0000 MHZ
SYS ID) 0001 FLEET ID) ——
UNIT ID) —— SUBFL ID) —
SIZE CODE) — CON TN) —— HZ
CALL TYPE) —

FIGURE 3-7
Trunk Auto (during test)

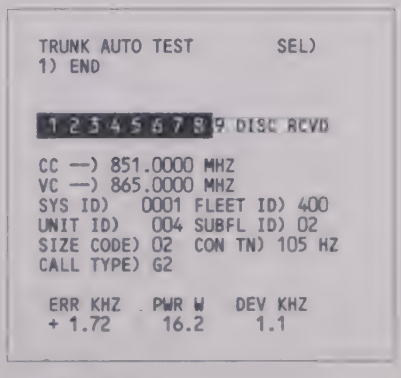

TRUNK AUTO TEST SEL)
1) END
1 2 3 4 5 6 7 8 9 DISC RCVD
CC —) 851.0000 MHZ
VC —) 865.0000 MHZ
SYS ID) 0001 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 02
SIZE CODE) 02 CON TN) 105 HZ
CALL TYPE) G2
ERR KHZ PWR W DEV KHZ
+ 1.72 16.2 1.1

FIGURE 3-8
Trunk Auto (during test)

the screen. When you unkey the radio, the next sequence begins.)

If you selected the printer option (and an external printer is connected and turned on), you will receive a channel-by-channel printout of the results. (The first screen is printed in its entirety. In subsequent screens, only the voice channel frequency, subfleet ID, frequency error, power, and frequency deviation are printed.)

If the printer is selected and a testing error (ERROR 10 through ERROR 29) occurs, the error is printed and the test progresses to the next frequency. If a setup error (ERROR 1 through ERROR 9) occurs, you must correct the error and restart the test. If the printer is *not* selected and a testing error occurs, the test stops. You can then continue the Trunk Auto test at the next voice channel or end the test.

In the Frequency Table mode the test ends after all four voice channels are tested. In the Variable Step mode the test ends when the frequency is equal to (or would exceed) 865.9875 MHz. See figure 3-9.

TRUNK AUTO TEST SEL)
1) EXIT
2) RESET
1 2 3 4 5 6 7 8 9 DISC SENT
CC —) 851.0000 MHZ
VC —) 865.0000 MHZ
SYS ID) 0001 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 02
SIZE CODE) 02 CON TN) 105 HZ
CALL TYPE) G2

FIGURE 3-9
Trunk Auto (after test)

If you have selected the printer, the following summary is printed at the end of the test:

total number of errors
total number of warnings
minimum and maximum power
minimum and maximum frequency deviation
maximum frequency error

When the test ends, you can press 1 to exit and return to the Trunking Menu. Or press 2 to reset the test—the Trunk Auto test can then be repeated on different voice channels or with different systems, fleets, or subfleets.

Problems

Refer to page 23 for a list of some typical problems and possible solutions.

Advanced User's Note

If you are running the Trunk Auto test in a semi-automated mode (you are keying and unkeying the radio), the subfleet selector on the radio can be changed to verify that all subfleets are operating. The subfleet will be printed out.

Controller Init Test Option

The Controller Init option is used to test the radio's ability to receive a call. It first tests the signaling ability of the radio and then lets you check radio power and sensitivity. You can test fleet and subfleet calls.

Pretest Adjustments

Before beginning the Controller Init test, make the following adjustments and selections to the R-2021D's front panel:

Duplex Gen	Off
RF Port Sel	RF In/Out
Image/Dplx	High
BW	Narrow
Squelch	Off
DISPLAY	Signaling Seq
FUNCTION	Generate-FM

One difference between the Radio Init test and the Controller Init test is that in this test the R-2021D is in Generate mode. The R-2021D generates on the control channel from the I/O port, rather than the DUPLEX GEN port. This allows you to adjust the RF level of the voice channel that is going to the radio being tested by adjusting the RF step attenuator and fine adjust. At very low signal levels (attenuator set greater than 90 dB), you should disconnect the DUPLEX GEN connection from the Iso-T coupler to increase the accuracy of this measurement.

The Test Screen

Press 2 in the Trunking Menu screen to enter the Controller Init test screen. Refer to figure 3-10.

In the middle of the screen, the thermometer graphic indicates the major signaling events. These events are different than the events in the Radio Init and Trunk Auto tests because the radio does not transmit. The signaling events are:

#	Help Message	Explanation
1	CC IDLE	The R-2021D is outputting a background pattern on the control channel frequency for the radio to lock onto.

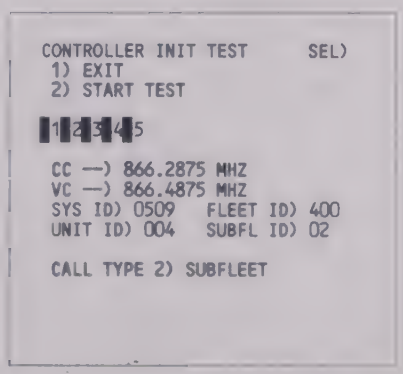

CONTROLLER INIT TEST SEL)
1) EXIT
2) START TEST
1 2 3 4 5
CC —) 866.2875 MHZ
VC —) 866.4875 MHZ
SYS ID) 0509 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 02
CALL TYPE 2) SUBFLEET

FIGURE 3-10
Controller Init (pretest)

2	CHAN GRANT	The R-2021D is sending a channel grant signaling word on the control channel frequency to tell the radio which voice channel to go to.
3	OBD HS ACK	The R-2021D is sending a high speed acknowledge word on the voice channel frequency.
4	OBD CONN	The R-2021D is sending an outbound connect word on the voice channel frequency.
5	DISC SENT	The R-2021D is sending a disconnect word on the voice channel frequency. (Only happens when you enter 1.)

In the Controller Init test screen, enter the following:

control channel frequency
voice channel frequency
system ID
fleet ID
subfleet ID
unit ID
call type

All ID and frequency information on the screen must be correct to call the radio being tested. If the radio was tested previously, information from that test is automatically transferred to the Controller Init test screen. But before you begin the Controller Init test, make sure that the transferred information is correct for the desired selections on the radio. In the CALL TYPE field, you specify the type of call to be sent. Enter 1 to initiate a fleet call, or 2 to initiate a subfleet call.

The Test

Position the cursor at the top of the Controller Init test screen, by SEL, and press 2 to initiate the test. The R-2021D then checks all data entered on the screen and, if everything is correct, the test starts.

Note: If you enter a system ID that is not in the System Configuration screen, an ERROR 03 is displayed and the test ends. (Whereas in the Radio Init test, if you enter a system ID that is not in the System Configuration screen, a warning is displayed and the test doesn't end.) See the Appendix for a list of error messages.

The R-2021D automatically enables the 20 KHz lowpass and 5 Hz highpass receive filters by selecting filter special functions 23 and 24. At the end of the test, the receive filters are returned to their pretest states (even if you enter filter special functions 20 through 26 during a temporary exit).

The R-2021D outputs a background pattern on the control channel frequency for the radio to lock onto. After a few seconds, the R-2021D sends a channel grant signaling word on the control channel frequency to tell the radio which voice channel to go to. The R-2021D then sends the radio a high speed acknowledge on the voice channel frequency. After the R-2021D sends the radio outbound connect words on the voice channel frequency, you're on the voice channel and you can key the transmitter to measure the radio's output power and test call back functioning. Refer to figure 3-11. The R-2021D can transmit modulation to the radio, but because the R-2021D is generating through the RF I/O port (Generate mode) it cannot receive any modulation from the radio.

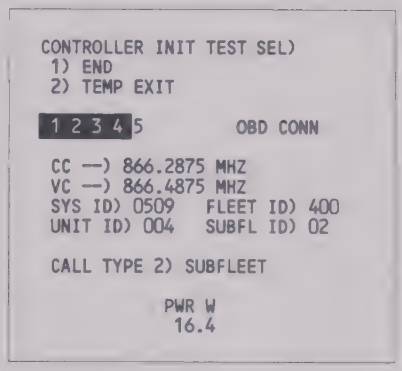


FIGURE 3-11
Controller Init (during test)

Note: If you entered 2 (subfleet) in the CALL TYPE field, you can key the transmitter. You cannot key the radio's transmitter if you entered 1 (fleet).

Complete the test by entering 1 to end the call. When you press 1, the R-2021D sends the radio a disconnect word on the voice channel frequency. A "TEST COMPLETED" message is displayed at the bottom of the screen. See figure 3-12. At this point, you have two choices. You can enter 1 to exit to the Trunking Menu screen, or enter 2 to reset the test.

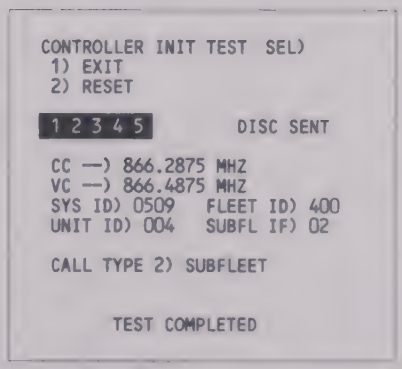


FIGURE 3-12
Controller Init (after test)

Temporary Exit

After step 4 is completed, you can do a temporary exit by entering 2. To return to the Controller Init test after a temporary exit, choose the Signaling Sequence display.

Problems

Following are some typical problems that might occur (in addition to a radio malfunction) and possible solutions.

- The radio will not go to the voice channel.

  The control channel entered is not a valid control channel frequency for the radio.

  The voice channel frequency entered is not a valid voice channel frequency for the radio.

  The system ID entered is not a valid system ID for the radio.

  Connections from the R-2021D to the radio are incorrect.

  Size codes in the System Configuration screen are incorrect for this system.

  RF attenuation is set too high.

  The fleet ID, subfleet ID, unit ID, or call type is not correct.

- The radio will not key up, but you can hear modulation from the R-2021D.

  A fleet call (rather than a subfleet call) was issued.

Advanced User's Note

In the Controller Init test, you can perform a sensitivity test. There will be a degradation from the published 12 dB SINAD sensitivity due to the transmitted connect word needed to keep the radio on the voice channel. To do the test, proceed as follows. After step 4 on the thermometer is completed, do a temporary exit to the Gen/Mon screen. Adjust the 1 KHz tone for the desired deviation (typically 3 KHz). Then connect the radio's received audio to the DVM scope jack on the R-2021D's front panel. Decrease the step attenuator and variable controls to obtain the desired SINAD, and read the output signal level from the lower portion of the Gen/Mon screen.

Section 4
Special Tests

General Information

In those Special Tests that require a system ID, you must enter a system ID that is in the System Configuration screen. Also, you cannot enter FFFF as the system ID. If you do enter a system ID that is not in the System Configuration screen, an ERROR 03 is displayed and the test ends. See the Appendix for a list of error and warning messages.

Special Test Menu

To enter the Special Test mode, press 4 from the Trunking Menu. If this is the first time you are using the Special Tests, the Special Test Menu is displayed (see figure 4-1). Otherwise, the screen of the most recently used Special Test is displayed.

Note: To exit the Special Test Menu, you have to be in one of the Special Test screens and exit through that test's screen.

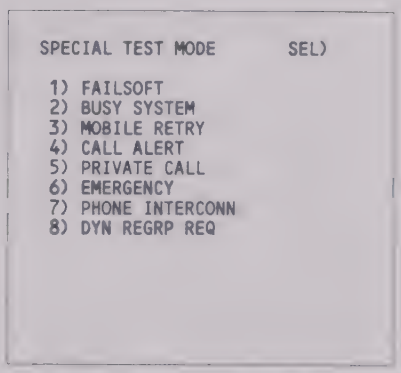


FIGURE 4-1
Special Test Menu

Failsoft Test Option

When the central controller becomes inoperative, the radio automatically reverts to its preassigned failsoft channel (system voice channel) and is capable of conventional repeater operation. The R-2021D simulates this condition by not outputting OSWs on the control channel; instead, it outputs the failsoft word on the failsoft channel. After the radio is on the failsoft channel, modulation can be sent in both directions, as in the Radio Init test.

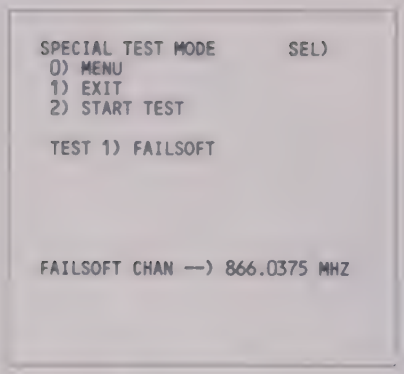


FIGURE 4-2
Failsoft (pretest)

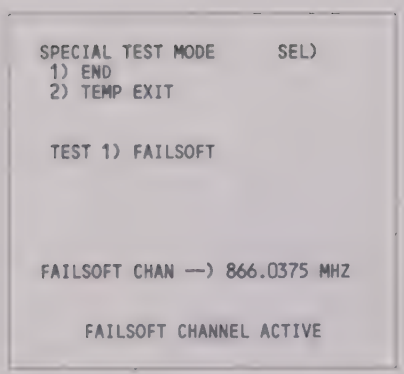


FIGURE 4-3
Failsoft (during test)

The Test Screen

Enter 1 from the Special Test Menu to access the Failsoft test screen. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 1.) The Failsoft test screen appears, as in figure 4-2. Pressing 0, MENU, will return you to the Special Test Menu. Entering 1, EXIT, will return you to the Trunking Menu.

The only item to enter is the failsoft channel frequency. Enter this frequency at the bottom of the screen by FAILSOFT CHAN.

The Test

To begin the test, position the cursor at the top of the Failsoft test screen, by SEL, and press 2. The system then checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error message is displayed.) The message "FAILSOFT CHANNEL ACTIVE" appears at the bottom of the screen, as in figure 4-3. This message indicates that the failsoft word is being output on the failsoft channel.

After the radio has locked onto the failsoft channel, you can transmit modulation from the R-2021D to the radio by turning on the 1 KHz tone, connecting a tone to the External Mod In jack, or talking through the R-2021D's microphone. You can also transmit from the radio to the R-2021D. To end the test, press 1. A "TEST ENDED" message is displayed.

Temporary Exit

Any time after the test has started, you can press 2 for a temporary exit. To return to the Failsoft test after a temporary exit, choose the Signaling Sequence display.

Busy System Test Option

Busy occurs when all voice channels on a system are busy. The central controller then outputs a busy signal to the radio. The radio indicates that it has received the busy signal by emitting a busy tone similar to a telephone busy tone. When a voice channel is clear, the central controller automatically calls back the radio and completes the call.

The R-2021D tests this capability by simulating the central controller. The Busy System test proceeds as in the Radio Init test until the R-2021D receives the radio's ISW. When the ISW is received, the R-2021D outputs a busy signal on the control channel and freezes the thermometer display at 2. When you enter 2 for a call back, the R-2021D and the radio complete the call.

The Test Screen

Enter 2 from the Special Test Menu to access the Busy System test. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 2.) Refer to figure 4-4. Option 0, MENU, will return you to the Special Test Menu. Option 1, EXIT, will return you to the Trunking Menu.

In the center of the screen, a thermometer style graphic indicates the major signaling events within the calling process. These signaling events are the same as those in the Radio Init test, except the radio's ID information is not displayed. You need to enter the following:

control channel frequency
voice channel frequency
system ID

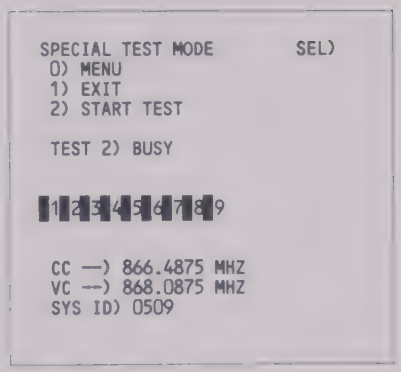


FIGURE 4-4
Busy System (pretest)

The Test

Move the cursor to the top of the Busy System test screen, by SEL, and press 2 to start the test. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error mesage appears.)

After the test starts, "CC IDLE" is displayed to the right of the thermometer. A beep-beep alarm sounds and a flashing message appears on the screen prompting you to key the radio. Key the transmitter to complete the call.

The thermometer display will stop after 2, indicating that the R-2021D has received the radio's ISW. "BUSY SYSTEM ACTIVE" is displayed at the bottom of the screen, as shown in figure 4-5. If you keep the radio keyed, you'll hear a busy tone. Press 2 (CALL BACK) to continue the call. The test continues without keying up. The R-2021D stops sending the busy signal and the call is completed.

The remainder of the test is like the Radio Init test. To complete step 8, the radio must be unkeyed to

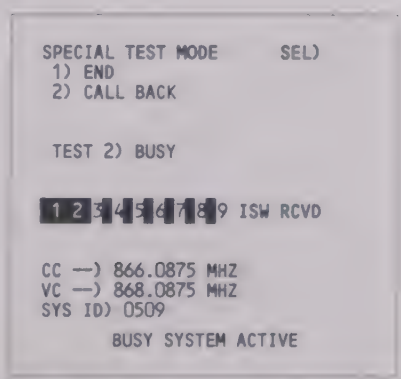

SPECIAL TEST MODE SEL)
1) END
2) CALL BACK
TEST 2) BUSY
1 2 3 4 5 6 7 8 9 ISW RCVD
CC —) 866.0875 MHZ
VC —) 868.0875 MHZ
SYS ID) 0509
BUSY SYSTEM ACTIVE

FIGURE 4-5
Busy System (during test)

initiate transmission of the disconnect tone. To complete step 9 and end the test, enter 1 at the top of the screen. "DISC SENT" is displayed to the right of the thermometer and "TEST COMPLETED" is displayed at the bottom of the screen. You can press 1 to exit to the Trunking Menu, or press 2 to reset the test.

Temporary Exit

After step 7 is completed, you can do a temporary exit by pressing 2. To return to the Busy System test, choose the Signaling Sequence display.

Mobile Retry Test Option

Mobile retry occurs when the radio attempts a call and does not receive a busy signal or a response to the ISW it sent. The radio keeps retrying by sending an ISW up to 15 times until a response is sent from the central controller.

The R-2021D tests this capability by simulating the central controller. The test proceeds as in the Radio Init test until step 1 is completed. The R-2021D (the base) ignores all ISWs until you press 2 (ACCEPT) to accept the ISW. After you enter 2, the test continues as in the Radio Init test.

The Test Screen

Enter 3 from the Special Test Menu to access the Mobile Retry test screen. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 3.) See figure 4-6. Option 0, MENU, will return you to the Special Test Menu. Option 1, EXIT, will return you to the Trunking Menu.

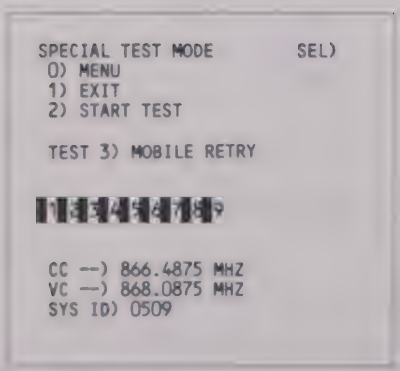


FIGURE 4-6
Mobile Retry (pretest)

In the center of the screen, a thermometer style graphic indicates the major signaling events within the calling process. These signaling events are the same as those in the Radio Init test. You need to enter the following information in the Mobile Retry screen:

control channel frequency
voice channel frequency
system ID

The Test

Start the test by moving the cursor to the top of the screen, by SEL, and pressing 2. The system then checks

all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error message is displayed.)

After the test starts, "CC IDLE" is displayed to the right of the thermometer. A beep-beep alarm sounds and a "KEY TRANSMITTER" message appears on the screen prompting you to key the transmitter. The thermometer display stops after step 1 until you key the transmitter. See figure 4-7. Key the transmitter and, if auto retry is working, the radio's transmit light will flash several times. The radio sends an ISW on the control channel frequency each time you key up to indicate that it is calling.

To continue the test, press 2 (ACCEPT) *while the radio is retrying.* (Note: If you press 2 after the radio has finished retrying, you'll have to rekey the radio.) The remaining signaling events are like those in the Radio Init test, except no information is displayed.

To complete step 8, you must dekey the radio to initiate transmission of the disconnect tone. To complete step 9 and end the test, press 1. The screen displays "DISC SENT" to the right of the thermometer and "TEST ENDED" at the bottom of the screen. You can press 1 to exit to the Trunking Menu, or press 2 to reset the test.

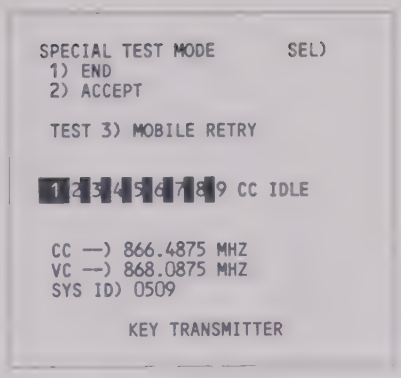


FIGURE 4-7
Mobile Retry (during test)

Temporary Exit

After step 7 is completed, you can do a temporary exit by pressing 2. To return to the Mobile Retry test, select the Signaling Sequence display.

Call Alert Test Option

The Call Alert Test has two options, a Radio Init Call Alert and a Controller Init Call Alert. Enter 4 in the Special Test Menu to access the Call Alert test. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 4.) Depending on which Call Alert test was last used, figure 4-8 (Radio Init) or figure 4-10 (Controller Init) is displayed.

Radio Init Call Alert

A radio init call alert is the radio call alerting another radio. You might use this option if you could not reach another radio. The R-2021D simulates the central controller and the target radio (the unit that the

radio being tested is trying to call alert). The R-2021D waits for the call alert ISW from the radio. When received, the R-2021D displays ID information about the target unit and simulates the target system acknowledging the call alert.

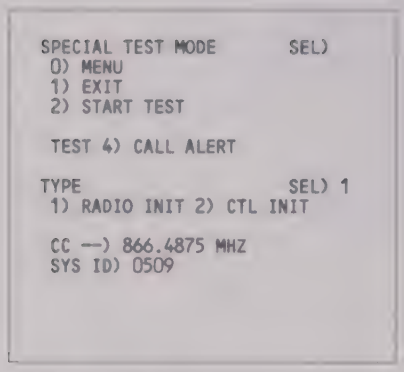


FIGURE 4-8
Radio Init Call Alert (pretest)

The Test Screen

To choose the Radio Init mode, position the cursor in the middle of the Call Alert screen, by TYPE SEL, and press 1. The Radio Init Call Alert screen is displayed, as in figure 4-8. Option 0, MENU, will return you to the Special Test Menu. Option 1, EXIT, will return you to the Trunking Menu.

For the Radio Init Call Alert test, enter the following:

control channel frequency
system ID

You must also set the radio being tested for a call alert type call.

The Test

Start the test by moving the cursor to the top of the screen, by MODE SEL, and pressing 2. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error message appears.)

The R-2021D outputs a background idle pattern on the control channel frequency. A beep-beep alarm sounds and the "KEY TRANSMITTER" prompt is displayed. When you key the radio, it sends the R-2021D a call alert ISW on the control channel frequency to indicate that it has called.

When the R-2021D receives the ISW, it decodes and displays the call type and the fleet ID, subfleet ID, and unit ID of the target radio (the unit the radio being tested is trying to call alert). The call type should be A. See figure 4-9. The radio should indicate in some way that a call alert has been sent (for example, the radio's transmit light flashes).

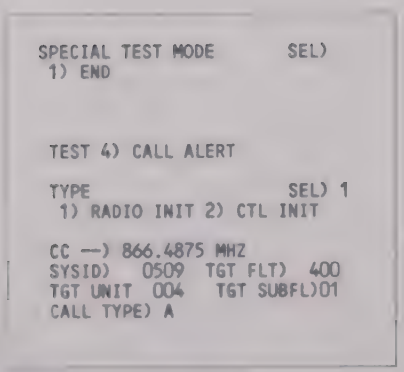

SPECIAL TEST MODE SEL)
1) END
TEST 4) CALL ALERT
TYPE SEL) 1
1) RADIO INIT 2) CTL INIT
CC —) 866.4875 MHZ
SYSID) 0509 TGT FLT) 400
TGT UNIT 004 TGT SUBFL)01
CALL TYPE) A

FIGURE 4-9
Radio Init Call Alert (during test)

The R-2021D then automatically sends an acknowledge to simulate the target system acknowledging the call alert. The radio should indicate that it has received the acknowledge signal (for example, the light stops flashing). A "TEST COMPLETED" is displayed. You can press 1 to exit to the Trunking Menu, or press 2 to reset the test.

Controller Init Call Alert

A controller init call alert is when another radio call alerts the radio being tested. The R-2021D simulates both the central controller and a radio trying to call alert the radio being tested. The R-2021D outputs a background idle pattern on the control channel frequency. When you press 2 (SEND OUTBOUND ALERT), the R-2021D sends a call alert word on the control channel. The radio then sends information to indicate that it has received the call alert. The R-2021D decodes and verifies the information, but the information is not displayed.

The Test Screen

To choose the Controller Init mode, position the cursor in the middle of the Call Alert screen, by TYPE SEL, and press 2. The Controller Init mode of the Call Alert test is displayed, as in figure 4-10. MENU (option 0) returns you to the Special Test Menu; EXIT (option 1) returns you to the Trunking Menu.

For the Controller Init Call Alert test, you need to enter:

control channel frequency
system ID
unit ID
fleet ID
subfleet ID

The Test

Position the cursor at the top of the Call Alert screen, by MODE SEL, and press 2 to start the test. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error message appears.)

SEND OUTBOUND ALERT (option 2) is displayed, as shown in figure 4-11. The control channel is now active. The R-2021D is sending a background idle pattern (background OSW) on the control channel frequency for the radio to lock onto. Press 2 (SEND OUTBOUND ALERT). The R-2021D simulates sending a call alert word to the radio on the control channel frequency. The radio should indicate in some way that a call alert has been received (for example, a flashing light).

The radio then sends back ID information to acknowledge the call alert. The R-2021D decodes the ID information to make sure it is correct and displays "TEST COMPLETED." The R-2021D does not display the received ID information. You can press 1 to exit to the Trunking Menu, or press 2 to reset the test.

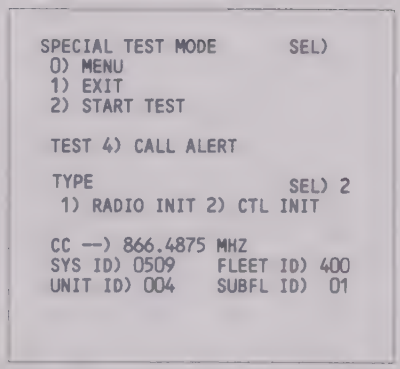

SPECIAL TEST MODE SEL)
0) MENU
1) EXIT
2) START TEST
TEST 4) CALL ALERT
TYPE SEL) 2
1) RADIO INIT 2) CTL INIT
CC —) 866.4875 MHZ
SYS ID) 0509 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 01

FIGURE 4-10
Controller Init Call Alert (pretest)

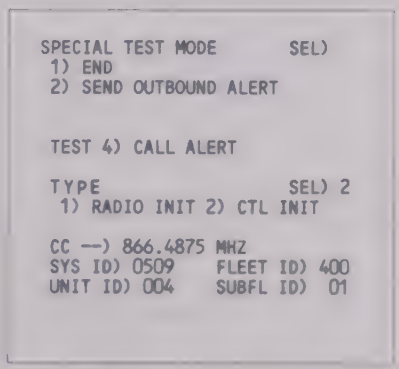

SPECIAL TEST MODE SEL)
1) END
2) SEND OUTBOUND ALERT
TEST 4) CALL ALERT
TYPE SEL) 2
1) RADIO INIT 2) CTL INIT
CC —) 866.4875 MHZ
SYS ID) 0509 FLEET ID) 400
UNIT ID) 004 SUBFL ID) 01

FIGURE 4-11
Controller Init Call Alert (during test)

Private Call Test Option

A private call is when you want to talk to the dispatcher or another radio without any other radio on the system getting the call. There are two types of private calls: Level 1 and Level 2. An individual radio can only do a Level 1 *OR* a Level 2 type call.

In a Level 1 private call, you can call any radio in your fleet or subfleet if you have a supervisor's radio. If you do not have a supervisor's radio, you can only call the dispatcher. In a Level 2 private call, the radio can call any radio in its system.

In the Private Call option, the R-2021D simulates both the central controller and the dispatcher. The R-2021D handles a Level 1 private call like the Radio Init test, except the call type is I1 and the target radio's ID information is displayed. (In a Radio Init test, the ID information of the radio being tested is displayed.) A Level 2 Private Call simulates a private call to one radio only (even though you can call more than one radio in a Level 2 call). The test progresses as in the Radio Init test, except the call type is I2 and the target information *and* the radio information is displayed.

The Test Screen

Enter 5 from the Special Test Menu to access the Private Call test. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 5.) The Private Call screen, shown in figure 4-12, is displayed. Option 0 (MENU) will return you to the Special Test Menu; Option 1 (EXIT) will return you to the Trunking Menu.

```
SPECIAL TEST MODE          SEL)
 0) MENU
 1) EXIT
 2) START TEST

 TEST 5) PRIVATE CALL



 CC --) 866.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-12
Private Call (pretest)

For the Private Call test (Level 1 or Level 2), enter the following information:

control channel frequency
voice channel frequency
system ID

You also have to set the radio being tested to do a private call.

The Test

To initiate the test, position the cursor at the top of the Private Call screen, by SEL, and press 2. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the entered data, an error message is displayed.)

In both Level 1 and Level 2 type calls, the test progresses as in a Radio Init test, except the call type is I1 for Level 1 and I2 for Level 2. When the "KEY TRANSMITTER" prompt is displayed, press the PTT switch to initiate the call. When you key up, the radio sends the R-2021D an ISW on the control channel frequency to indicate that it has called.

Note: After you key the radio, the R-2021D determines if the radio is making a Level 1 or Level 2 private call.

The R-2021D decodes the received ISW. If the radio is making a Level 1 private call, the R-2021D displays the fleet, subfleet, and unit ID. A call type of I1 is also displayed. Refer to figure 4-13. If the radio is making a Level 2 private call, the R-2021D displays the target fleet ID, target subfleet ID, and target unit ID (in addition to displaying a call type of I2 and the radio's ID information). See figure 4-14. In both a Level 1 call and Level 2 call, you must dekey the radio to initiate transmission of the disconnect tone. At this point, you can end the test or continue to the Controller Init Private Call.

To end the test, press 1. (Before ending the test, you can go to other display screens in the R-2021D.) The R-2021D sends a disconnect pattern to the radio on the voice channel frequency to return the radio to the control channel. When the Private Call test is completed, a "TEST ENDED" message is displayed. You can press 1 to exit to Trunking Menu, or press 2 to reset the test.

To continue to the Controller Init Private Call (after dekeying the radio), press 3 (CONTINUE TO CTL TEST). At the top of the screen, a new option 2, SEND CALL TO RADIO, is displayed. See figure 4-15 (Level 1 type call) and figure 4-16 (Level 2 type call). If it's a Level 1 Private Call, you can change the unit ID if desired. (The unit ID is the only item that can be changed.) After you press 2 the test continues as in a Controller Init test, except the radio will indicate in some way that it has received a private call (for example, a light on the radio will flash).

Temporary Exit

In both Level 1 and Level 2 type calls, you can do a temporary exit after the radio is on the voice channel

```
SPECIAL TEST MODE        SEL)
 1) END
 2) TEMP EXIT
 3) CONTINUE TO CTL TEST

 TEST 5) PRIVATE CALL

 FLEET ID)  400
 SUBFL ID)   01
 UNIT ID)   004
 CALL TYPE)  I1
 CC --) 866.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-13
Radio Init Private Call, Level 1 (during test)

```
SPECIAL TEST MODE        SEL)
 1) END
 2) TEMP EXIT
 3) CONTINUE TO CTL TEST

 TEST 5) PRIVATE CALL

 FLEET ID) 400   TGT FLEET)400
 SUBFL ID)  01   TGT SUBFL) 01
 UNIT ID)  004   TGT UNIT) 003
 CALL TYPE) I2
 CC --) 866.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-14
Radio Init Private Call, Level 2 (during test)

```
SPECIAL TEST MODE        SEL)
 1) END
 2) SEND CALL TO RADIO

 TEST 5) PRIVATE CALL

 FLEET ID)  400
 SUBFL ID)   01
 UNIT ID)   004
 CALL TYPE)  I1
 CC --) 866.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-15
Controller Init Private Call, Level 1 (during test)

```
SPECIAL TEST MODE        SEL)
 1) END
 2) SEND CALL TO RADIO

 TEST 5) PRIVATE CALL

 FLEET ID) 400    TGT FLEET)400
 SUBFL ID)  01    TGT SUBFL) 01
 UNIT ID)  004    TGT UNIT) 003
 CALL TYPE) I2
 CC --) 866.4875 MHZ
 VC --) 868.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-16
Controller Init Private Call, Level 2 (during test)

by pressing 2. To return to the Private Call test, choose the Signaling Sequence display.

Emergency Test Option

In an emergency call, the radio sends the dispatcher an emergency alarm ISW on the control channel. The controller then opens a voice channel for the requesting radio even if all voice channels are full. The central controller also acknowledges the message by sending an emergency OSW on the control channel.

The R-2021D tests this capability by simulating the central controller and the dispatcher. The test is similar to a Radio Init test, except the radio sends an emergency ISW. The R-2021D responds by sending an OSW. The R-2021D also sends an acknowledge to the emergency call.

Note: The Emergency option only tests an emergency alarm.

The Test Screen

Press 6 in the Special Test Menu to access the Emergency test screen. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 6.) See figure 4-17. Option 0, MENU, returns you to the Special Test Menu. Option 1, EXIT, exits to the Trunking Menu.

Enter the following information:

control channel frequency
system ID

```
SPECIAL TEST MODE        SEL)
 0) MENU
 1) EXIT
 2) START TEST

 TEST 6) EMERGENCY




 CC --) 866.4875 MHZ
 SYS ID) 0509
```

FIGURE 4-17
Emergency (pretest)

The Test

Start the test by moving the cursor to the top of the Emergency test screen, by SEL, and pressing 2. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the data, an error message is displayed.)

After the test starts, a beep-beep alarm sounds and a flashing message appears on the screen prompting you to key the radio. Press the emergency switch to initiate the call. The radio sends an emergency alarm

ISW on the control channel frequency. The radio continues sending emergency alarm words until the R-2021D responds.

The R-2021D, simulating the central controller, responds to the ISW by sending an emergency OSW on the control channel. The R-2021D then sends an acknowledge, which simulates the dispatcher acknowledging the emergency call. Then, the R-2021D decodes the ISW and displays the radio's fleet ID, subfleet ID, unit ID, and call type. Refer to figure 4-18.

The test ends after the response and acknowledge are sent. The screen displays "TEST COMPLETED." You can press 1 to return to the Trunking Menu or press 2 to reset the test.

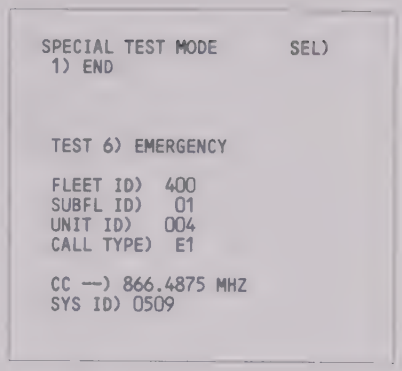


FIGURE 4-18
Emergency (during test)

Phone Interconnect Test Option

The Phone Interconnect Special Test has two steps, a Radio Init Phone Interconnect and a Controller Init Phone Interconnect. Enter 7 from the Special Test Menu to access the Phone Interconnect test. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 7.) The Phone Interconnect test screen, shown in figure 4-19, is displayed. Option 0, MENU, returns you to the Special Test Menu. Option 1, EXIT, exits to the Trunking Menu.

Radio Init Phone Interconnect

In a radio init phone interconnect, the radio makes a phone interconnect type call. The controller assigns a voice channel to the radio and puts a dial tone on the voice channel. After the radio sends an access number, you can call and talk on standard phone lines.

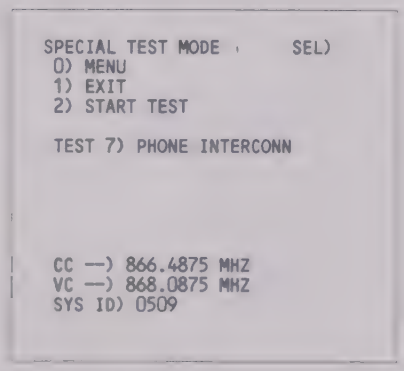


FIGURE 4-19
Radio Init Phone Interconnect (pretest)

The R-2021D tests this capability by simulating the central controller. After receiving the special phone interconnect ISW, the R-2021D continues with the same acknowledge and connect signaling as in the Radio Init test until you're on the voice channel. When you're on the voice channel, you can encode and decode DTMF, and also work in full duplex (if the radio is so equipped).

The Test

To use the Radio Init Phone Interconnect test, enter:

control channel frequency
voice channel frequency
system ID

Start the test by moving the cursor to the top of the screen, by SEL, and pressing 2. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the data, an error message is displayed.) The test progresses as in a Radio Init test, except phone interconnect (rather than channel grant) OSWs are sent.

After the test starts, a beep-beep alarm sounds and a "KEY TRANSMITTER" prompt is displayed. Press the phone interconnect call button on the radio to inititate a phone interconnect call. When you press the call button, the radio sends a phone interconnect ISW on the control channel frequency. The R-2021D decodes the received phone interconnect ISW and displays the radio's fleet ID and unit ID. The call type is also displayed.

The R-2021D completes acknowledge and connect signaling like in the Radio Init test, except a phone interconnect OSW is sent rather than the usual channel grant OSW and the test stops after the radio sends the R-2021D a connect word on the voice channel. The screen now displays two new options: DTMF ENCODE/DECODE and TEST PHONE HANGUP, as shown in figure 4-20.

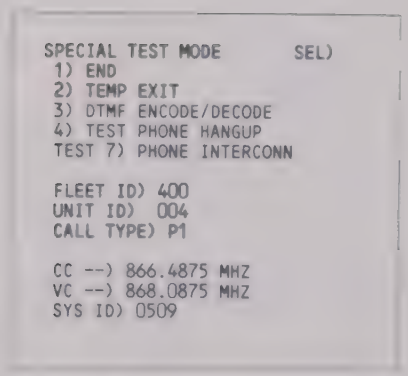


FIGURE 4-20
Radio Init Phone Interconnect (during test)

At this point, you're on the voice channel and you should be able to talk with the R-2021D. If you want to test the DTMF capability of the radio, press 3 (DTMF ENCODE/DECODE) to decode the radio's DTMF characters that are sent when you enter numbers on the radio keypad. (But you don't have to select the DTMF option.) If you press 3, the DTMF screen is displayed. Use the DTMF facility as described in the section on DTMF, page 11. When you have checked the DTMF capability of the radio, press 0 to return to the Phone Interconnect (Radio Init) test screen.

To test the phone interconnect hangup capability, press 4 (TEST PHONE HANGUP). After you press 4, the R-2021D returns to the control channel and waits for a phone interconnect hangup ISW. Press the phone hangup button on the radio to send the phone interconnect hangup ISW.

The R-2021D outputs a phone interconnect hangup acknowledge to the radio on the control channel and the Radio Init portion of the Phone Interconnect test is completed. The screen displays option 2 (SEND CALL TO

RADIO), as shown in figure 4-21. You can now run the Controller Init Phone Interconnect test or end the test by pressing 1.

```
SPECIAL TEST MODE        SEL)
 1) END
 2) SEND CALL TO RADIO

 TEST 7) PHONE INTERCONN

 FLEET ID) 400
 UNIT ID)  004
 CALL TYPE) P1

 CC --) 866.4875 MHZ
 VC --) 868.0875 MHZ
 SYS ID) 0509
```

FIGURE 4-21
Radio Init Phone Interconnect (after test)

Controller Init Phone Interconnect

In a controller init phone interconnect, another radio is calling the radio being tested, requesting a phone interconnect call. The R-2021D tests this capability by simulating the controller and the calling radio. In the Controller Init mode, you can test outgoing calls to the radio.

Note: If you want to do the Controller Init Phone Interconnect test, you must first run the Radio Init Phone Interconnect test. This is because the R-2021D has to determine the type of radio you're using.

The Test

All information displayed on the screen when the Radio Init Phone Interconnect test ended is retained on the Controller Init Phone Interconnect screen. You cannot change any information or enter new information. Press 2 (SEND CALL TO RADIO) and the R-2021D sends the radio a transpond OSW on the control channel. The radio sends back a transpond ISW automatically.

After the R-2021D receives the transpond ISW, it outputs a ring OSW on the control channel. The radio should now start ringing like a telephone. Press the key on the radio for phone offhook, and the radio sends a mobile request ISW on the control channel.

After you're on the voice channel, the screen displays option 3, DTMF ENCODE/DECODE, and option 4, TEST PHONE HANGUP. At this point, the test is similar to the Radio Init Phone Interconnect test. The only difference is that after you test phone hangup (option 4), the test ends automatically and "TEST COMPLETED" is displayed.

Temporary Exit

After you're on the voice channel (in the Radio Init and Controller Init Phone Interconnect tests) you can press 2 for a temporary exit. To return to the Phone Interconnect test, select the Signaling Sequence display.

Dynamic Regroup Request Test Option

Dynamic regroup allows a dispatcher to change the fleet or subfleet assignment of a radio or group of radios without any activity required by the radio users. The R-2021D will not actually regroup a radio, but it will decode a dynamic regroup request from the radio being tested. The R-2021D sends an acknowledge and the test is completed. This verifies the programming of the radio and the function of the selector switch.

The Test Screen

Enter 8 from the Special Test Menu to access the Dynamic Regroup Request test screen. See figure 4-22. (Or, if you're in one of the other Special Test screens, position the cursor in the middle of the screen, by TEST, and press 8.) Option 0 (MENU) returns you to the Special Test Menu; option 1 (EXIT) exits to the Trunking Menu.

At the bottom of the screen, enter:

control channel frequency
system ID

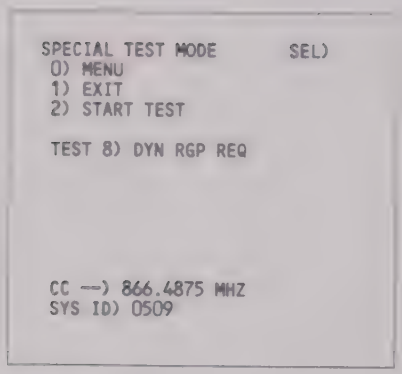


FIGURE 4-22
Dynamic Regroup Request (pretest)

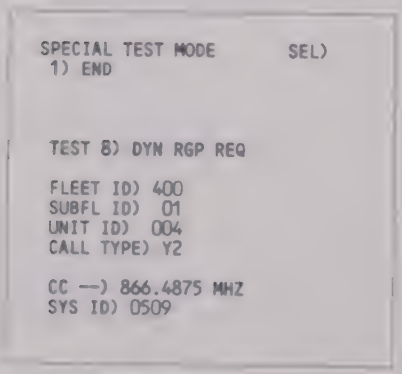


FIGURE 4-23
Dynamic Regroup Request (during test)

The Test

Start the test by moving the cursor to the top of the screen, by SEL, and pressing 2. The system checks all data entered on the screen and, if everything is correct, the test starts. (If there is a problem with the data, an error message is displayed.)

The radio sends the R-2021D a dynamic regroup request ISW on the control channel frequency. The R-2021D responds by sending acknowledge words on the control channel to acknowledge the ISW. The R-2021D then decodes the ISW and displays the radio's fleet ID, subfleet ID, and unit ID information. The call type is also displayed. Refer to figure 4-23.

The test ends automatically after the acknowledge is sent. A "TEST ENDED" message is displayed. At this point, you can press 1 to return to the Trunking Menu or press 2 to reset the test.

Appendix 1

Error and Warning Messages

Errors

If an error occurs during a test, the test ends. To run the test again, you must correct the mistake and restart the test. Errors fall into two categories: setup errors and radio errors. Error numbers 1 through 9 are setup errors (only 1 through 5 are used at this time); these occur when you enter incorrect data. Error numbers 10 through 29 are testing errors (only 10 through 16 are used at this time); these errors are the result of a radio error. If a testing error occurs during the Variable Step mode of the Trunk Auto test and the printer is selected, the test automatically resets and progresses to the next voice channel. A summary of setup and radio error messages follows.

Setup Error Messages

Error 01
Invalid frequency

The control or voice channel entered is out of the valid frequency range (851.0000 to 865.9875 MHz); or the control channel is not in 12.5 KHz increments from 851.0000 MHz; or the voice channel is not in 25 KHz increments from the control channel.

Error 02
Invalid fleet ID, subfleet ID, or unit ID

The value of the fleet ID, subfleet ID, or unit ID is greater than the maximum value for the size code value in the System Configuration screen. (The system ID determines which table is used; the fleet prefix determines which size code is used.)

Error 03
Invalid system ID

Indicates the system ID selected in the Controller Init test or one of the Special Tests is not one of the system IDs in the System Configuration screen.

Error 04
Invalid fleet map

The size code table in the System Configuration screen is incorrect for the system ID selected or the size code table is invalid for the data received in the ISW from the radio.

Error 05
Invalid size code

An undefined size code is entered in the System Configuration screen for the system ID selected.

Testing Error Messages

Error 10
ISW Data Error

The ISW bit rate is incorrect or there is a parity check error in the data received.

Error 11
Acknowledge Tone Note Received

No acknowledge tone was received in the time allowed.

Error 12
Connect Tone Not Received

No connect tone was received in the time allowed.

Error 13
Timeout

A response from the radio was not received in the time allowed.

Error 14
Incorrect Call Type Received

There is a radio problem or you attempted to make the wrong type of call for the test mode selected on the R-2021D.

Error 15
Disconnect Tone Not Received

Indicates disconnect tone was not received.

Error 16
ISW Not Received

Indicates ISW was not received from the radio in the time allowed.

Warnings

Warnings can also be displayed during a test. Unlike an error, the test continues if a warning occurs; the warning prompts you that a mistake has been made. A summary of warning messages follows.

Warning 01
Invalid System ID

The system ID selected in the Radio Init or the Trunk Auto test is not one of the system IDs in the System Configuration screen.

Warning 10
Incorrect Call Type Received

There is either a radio problem or you attempted to make the wrong type of call for the test mode selected on the R-2021D.

Appendix 2
ISW Call Type Description

CALL TYPE	DESCRIPTION
A	Individual Call Alert
E	Emergency Alarm
G1	Subfleet or Fleetwide Call, 5 Channel
G2	Subfleet or Fleetwide Call, 20 Channel
I1	Private Call, Level 1
I2	Private Call, Level 2
M	Status Message
P	Phone Interconnect Request
R	Interconnect Reject Request
S	System Wide Request
X	Extended Function Code
Y	Dynamic Regrouping

The call type field may contain an integer not listed here. This integer refers to a system level parameter. Refer to your system manager for its meaning.

Quick Reference Guide

This is a quick reference guide for using the trunking tests. For each test, the following is listed: the information you have to enter in the test screen, what the R-2021D checks before the test, what the R-2021D displays during the test, the thermometer description, and temporary exits. In addition, the R-2021D checks the following, when applicable:

Control channel is in 12.5 KHz increments from 851.0000 MHz

Voice channel is in 25 KHz increments from control channel

Control channel or voice channel is in the frequency range of 851.0000 to 865.9875 MHz

Radio Init Test

Enter:

Control channel frequency
Voice channel frequency
System ID

Checks:

System ID in System Configuration screen. If the system ID is not in the System Configuration screen or the system ID is FFFF, the R-2021D generates a WARNING 01 and can't display the decoded information.

Thermometer description:

1	CC IDLE	R-2021D outputs a background pattern on the control channel frequency.
2	ISW RCVD	Radio has sent an ISW on the control channel frequency.

3	CHAN GRANT	R-2021D sends channel grant signaling words on the control channel frequency.
4	OBD HS ACK	R-2021D sends high speed acknowledge words on the voice channel frequency.
5	IBD HS ACK	Radio sends a high speed acknowledge tone on the voice channel frequency.
6	OBD CONN	R-2021D sends an outbound connect word on the voice channel frequency.
7	CONN ON VC	Radio sends a connect tone on the voice channel frequency.
8	DISC RCVD	R-2021D confirms receipt of the disconnect tone from the radio on the voice channel.
9	DISC SENT	R-2021D sends a disconnect word on the voice channel frequency.

Displays:
- Fleet ID
- Subfleet ID
- Unit ID
- Size code
- Call type
- Connect tone
- Frequency error
- Power
- Deviation

Temporary exit:
- Available after step 7.

Trunk Auto Test

Enter:
- Control channel frequency
- System ID
- Four voice channel frequencies (in Frequency Table mode
- Starting voice channel frequency (in Variable Step mode
- Skip factor (in Variable Step mode)
- Printer on/off

Checks:

System ID in System Configuration screen. If the system ID is not in the System Configuration screen or the system ID is FFFF, the R-2021D generates a WARNING 01 and can't display the decoded information.

Thermometer description:

Same as the Radio Init test.

Displays:

Fleet ID
Subfleet ID
Unit ID
Size code
Call type
Connect tone
Frequency error
Power
Deviation

Temporary exit:

Not available.

Controller Init Test

Enter:

Control channel frequency
Voice channel frequency
System ID
Fleet ID
Subfleet ID
Unit ID
Call type

Checks:

System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Fleet, subfleet, and unit ID values are not greater than the maximum values for the size code value in the System Configuration screen. (The system ID determines which table is used, the fleet prefix determines which size code is used.)

Thermometer description:

1	CC IDLE	R-2021D outputs a background pattern on the control channel frequency.
2	CHAN GRANT	R-2021D sends a channel grant signaling word on the control channel frequency.

3 OBD HS ACK R-2021D sends a high speed acknowledge on the voice channel frequency.

4 OBD CONN R-2021D sends an outbound connect word on the voice channel frequency.

5 DISC SENT R-2021D sends a disconnect word on the voice channel frequency.

Displays:
Power

Temporary Exit:
Available after step 4.

Failsoft Test

Enter:
Failsoft channel frequency

Checks:
Failsoft frequency is in 12.5 KHz increments from 851.0000 MHz.

Thermometer Description:
No thermometer display.

Displays:
No information is displayed.

Temporary Exit:
Available any time after the test has started.

Busy System Test

Enter:
Control channel frequency
Voice channel frequency
System ID

Checks:
System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
Same as the Radio Init test.

Displays:
No information is displayed.

Temporary Exit:
Available after step 7.

Mobile Retry Test

Enter:
- Control channel frequency
- Voice channel frequency
- System ID

Checks:
- System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
- Same as the Radio Init test.

Displays:
- No information is displayed.

Temporary Exit:
- Available after step 7.

Radio Init Call Alert Test

Enter:
- Control channel frequency
- System ID

Checks:
- System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
- No thermometer display.

Displays:
- Target fleet ID
- Target subfleet ID
- Target unit ID
- Call type

Temporary Exit:
- Not available.

Controller Init Call Alert Test

Enter:
- Control channel frequency
- System ID
- Fleet ID
- Subfleet ID
- Unit ID

Checks:

System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Fleet, subfleet, and unit ID values are not greater than the maximum values for the size code value in the System Configuration screen.

Thermometer Description:

No thermometer display.

Displays:

No information is displayed

Temporary Exit:

Not available.

Private Call Test

Enter:

Control channel frequency
Voice channel frequency
System ID

Checks:

System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:

No thermometer display.

Displays:

Target fleet ID (Level 2 only)
Target subfleet ID (Level 2 only)
Target unit ID (Level 2 only)
Call type
Fleet ID
Subfleet ID
Unit ID

Temporary Exit:

Available after you're on the voice channel.

Emergency Test

Enter:

Control channel frequency
System ID

Checks:
System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
No thermometer display.

Displays:
Fleet ID
Subfleet ID
Unit ID

Temporary Exit:
Not available.

Radio Init Phone Interconnect Test

Enter:
Control channel frequency
Voice channel frequency
System ID

Checks:
System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
No thermometer display.

Displays:
Fleet ID
Subfleet ID
Unit ID

Temporary Exit:
Available after you're on the voice channel.

Controller Init Phone Interconnect Test

Enter:
Control channel frequency
Voice channel frequency
System ID

Checks:
System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Fleet, subfleet, and unit ID values are not greater than the maximum values for the size code value in the System Configuration screen.

Thermometer Description:
No thermometer display.

Displays:
No new information is displayed.

Temporary Exit:
Available after you're on the voice channel.

Dynamic Regroup Request Test

Enter:
Control channel frequency
System ID

Checks:
System ID in System Configuration screen. If the system ID is not in the System Configuration screen, the R-2021D generates an ERROR 03.

Thermometer Description:
No thermometer display.

Displays:
Fleet ID
Subfleet ID
Unit ID

Temporary Exit:
Not available.

MOTOROLA, INC.
COMMUNICATIONS SECTOR
TEST EQUIPMENT SERVICE CENTER
1313 EAST ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60196

TEST EQUIPMENT SERVICE CENTER
2333 B. Utah Avenue, El Segundo, CA

TEST EQUIPMENT SERVICE REQUEST FORM

This completed form must accompany equipment returned for service.

CUSTOMER'S PURCHASE ORDER NO.		DATE	
MODEL NUMBER		SERIAL NUMBER	
DESCRIPTION OF PROBLEM:			
REQUESTED SERVICE:			
SHIP TO ADDRESS:			
SHIP VIA:			

Providing the information below will reduce the turnaround time on your Test Equipment Service.

MOTOROLA CUSTOMER NUMBER	BILL TAG	SHIP TAG	INTERNAL MOTOROLA ACCOUNT NO.

SIGNED: _____

OPERATOR'S MANUAL
TRUNKED RADIO
TEST OPTION

R-2021D
68P80310B08-A

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